

CFSv2 in the context of NMME and IMME

Huug van den Dool

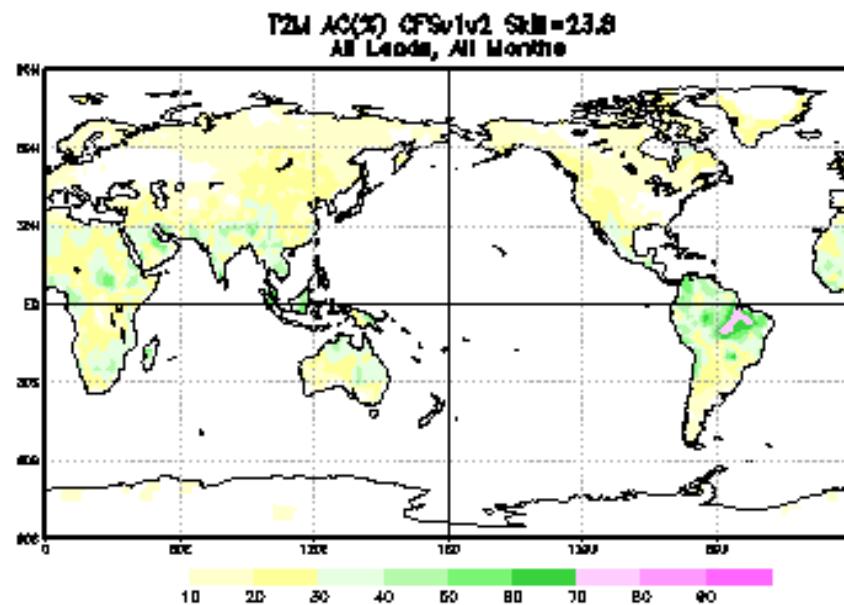
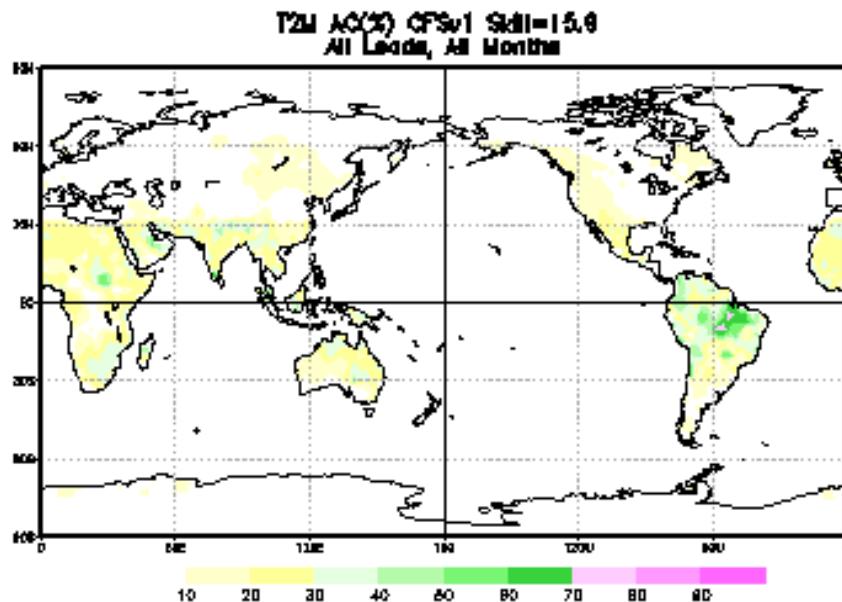
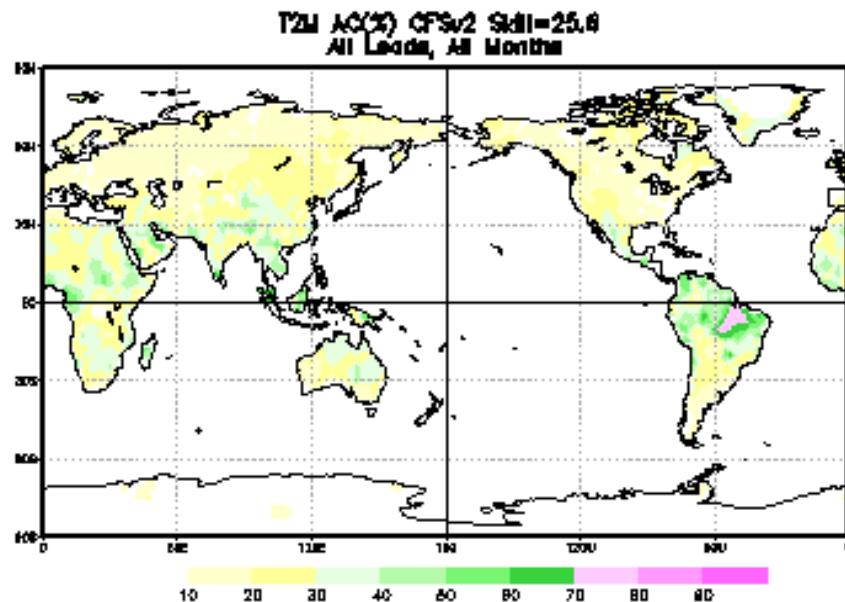
Your one stop shopping for IMME and
NMME:

[http://www.cpc.ncep.noaa.gov/products/
NMME/](http://www.cpc.ncep.noaa.gov/products/NMME/)

Area Averaged Correlation (R^2) Over North America: Model Ranks

| | Mod A | Mod B | Mod C | Mod D | Mod E | Mod F | Mod G | NMME |
|--------------------------|-------|-------|-------|-------|-------|-------|-------|------|
| JFM P (August IC) | 4 | 6 | 5 | 8 | 7 | 3 | 2 | 1 |
| JFM T2m (August IC) | 3 | 1 | 5 | 6 | 7 | 4 | 8 | 2 |
| MJJ P (December IC) | 5 | 7 | 1 | 2 | 8 | 6 | 3 | 4 |
| MJJ T2m (December IC) | 6 | 1 | 3 | 4 | 8 | 7 | 5 | 2 |
| Mean Rank | 4.5 | 3.75 | 3.5 | 5.0 | 7.5 | 5.0 | 4.5 | 2.2 |

Canadians, Kirtman



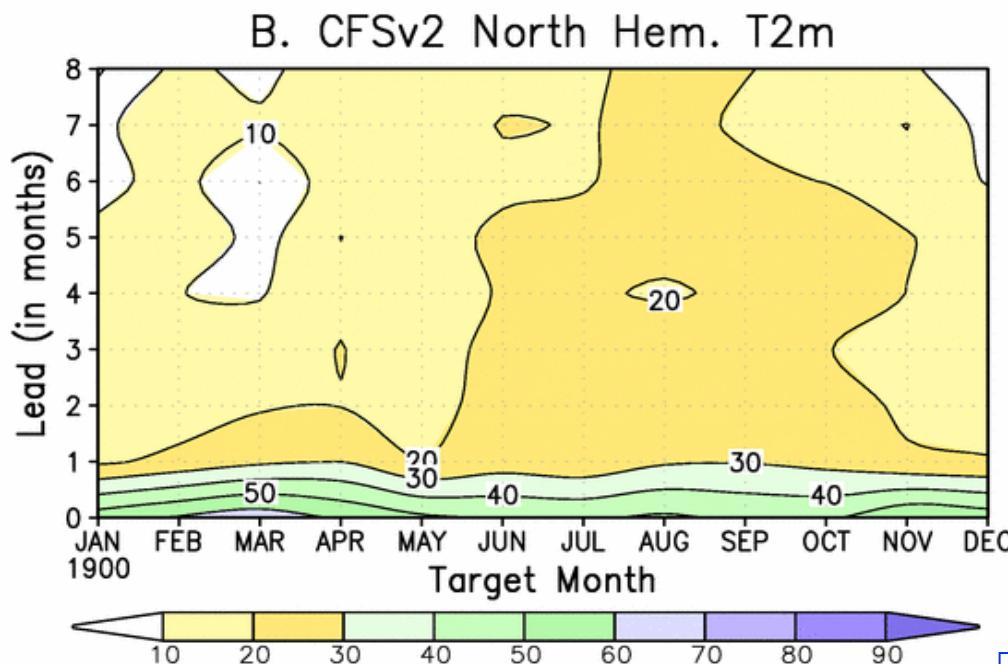
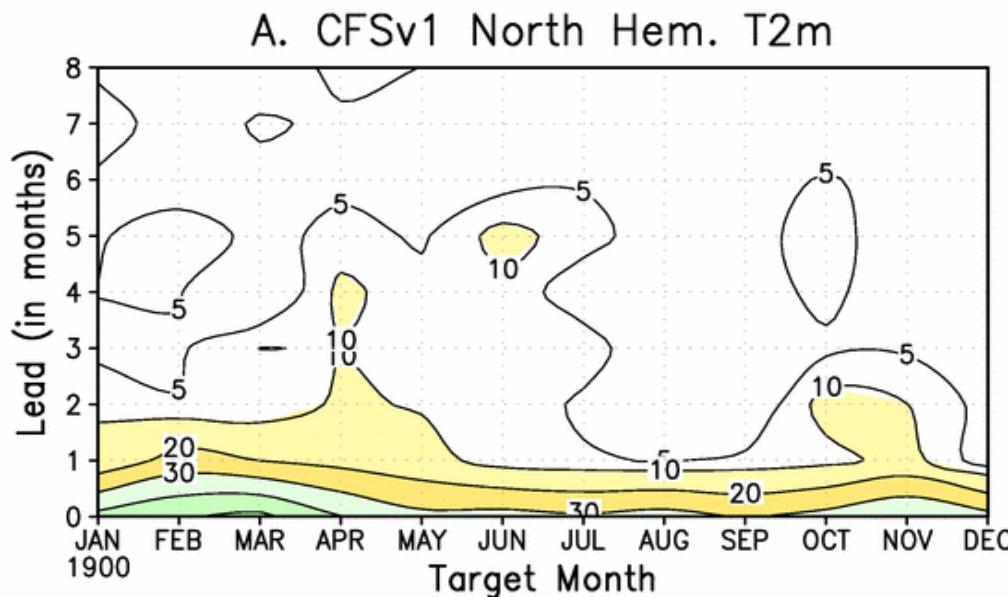
2-meter Temps AC
(All Leads, All Months)

CFSv2: **25.6**

CFSv1: **15.9**

CFSv1v2: **23.8**

More skill globally for CFSv2



2-meter Temperature Ensemble skill of Northern Hemisphere (all land north of 20°N)

CFSv2 clearly has more skill

2-meter Temps AC

(All Leads, All Months)

CFSv2: **25.6**

CFSv1: **15.9**

CFSv1v2: **23.8**

**More skill globally for
CFSv2**

Sea Surface Temp AC

(All Leads, All Months)

CFSv2: **36.5**

CFSv1: **32.4**

CFSv1v2: **40.1**

**More skill west of the
dateline and over the
Atlantic for CFSv2**

More details:
Suru Saha's talk

Precipitation AC

(All Leads, All Months)

CFSv2: **14.9**

CFSv1: **13.3**

CFSv1v2: **16.2**

**More skill in the
Western Pacific for
CFSv2**

Anomaly Correlation for other Regions (collaboration with EUROSIP and India)

All Leads (1-8), All Months (10)

| | Green is good | Red is not good | (acknowledge Steve Lord) | | | |
|---------------|----------------------|------------------------|---------------------------------|--------|----------|----------|
| Model | US T | Europe T | India T | US P | Europe P | India P |
| CFSv2 | 16.3 | 16.4 | 48.1 | 9.5 | 6.0 | 18.9 |
| CFSv1 | 9.5 | 9.6 | 2.4 | 10.3 | 4.5 | 18.0 |
| CFSv1v2 | 15.4 | 15.5 | 30.7 | 12.2 | 6.2 | 22.8 |
| CFSv1v2-CFSv2 | -0.9 | -0.9 | -18.1 | +2.7 | +0.2 | (+3.9) |
| %tage change | (-5.8%) | (-5.8%) | (-59%) | (+22%) | (+3.2%) | (+17.1%) |

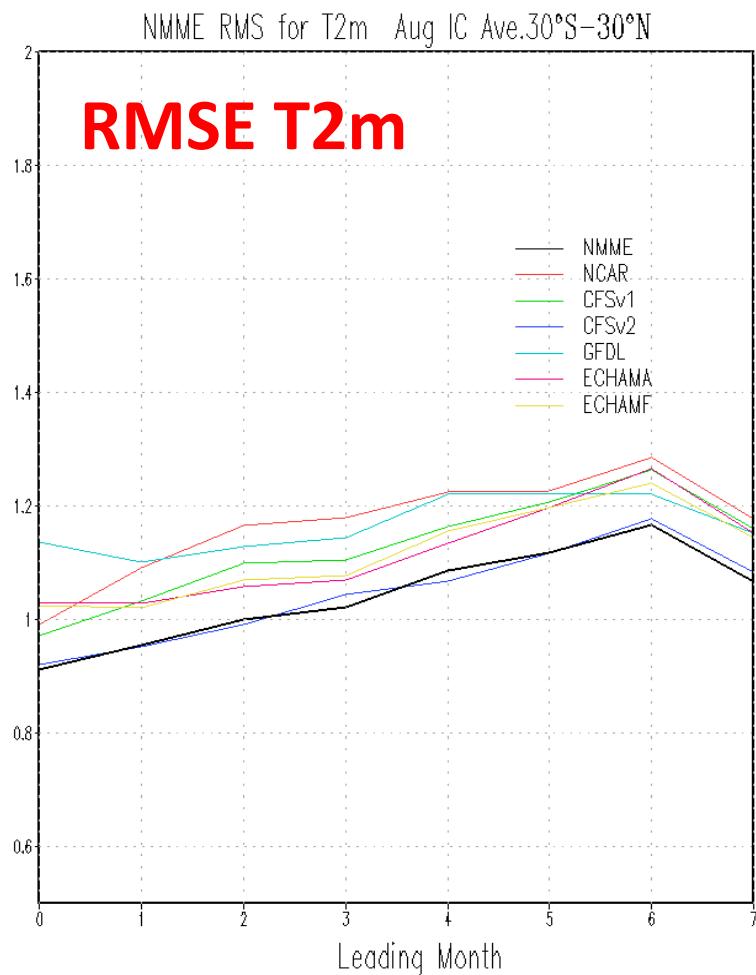
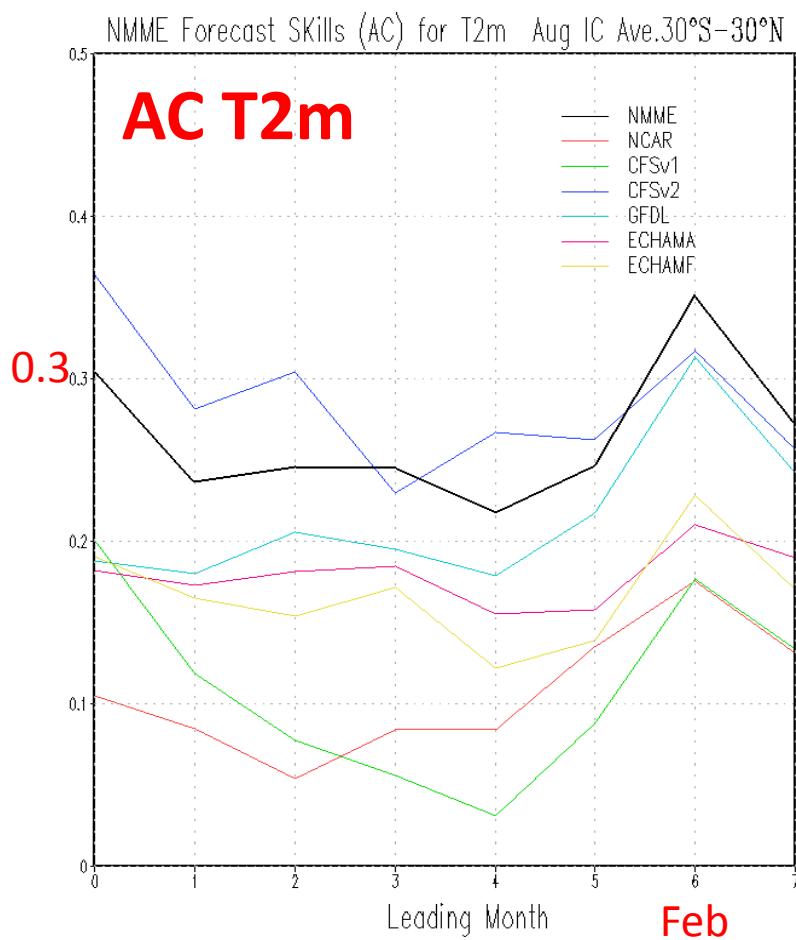
Definitions and Data

- AC of ensemble averaged monthly means
- GHCN-CAMS (validation for Tmp2m)
- CMAP (validation for Prate)
- OIv2 (validation for SST)
- 1982-2009 (28 years)
- Common 2.5 degree grid
- Variables/areas studied: US T, US P, global and Nino34 SST, global and Nino34 Prate.
- **A split climatology:** Two climos used for all variables within tropics
30S-30N: 1982-1998 and 1999-2009
Elsewhere: 1982-2009

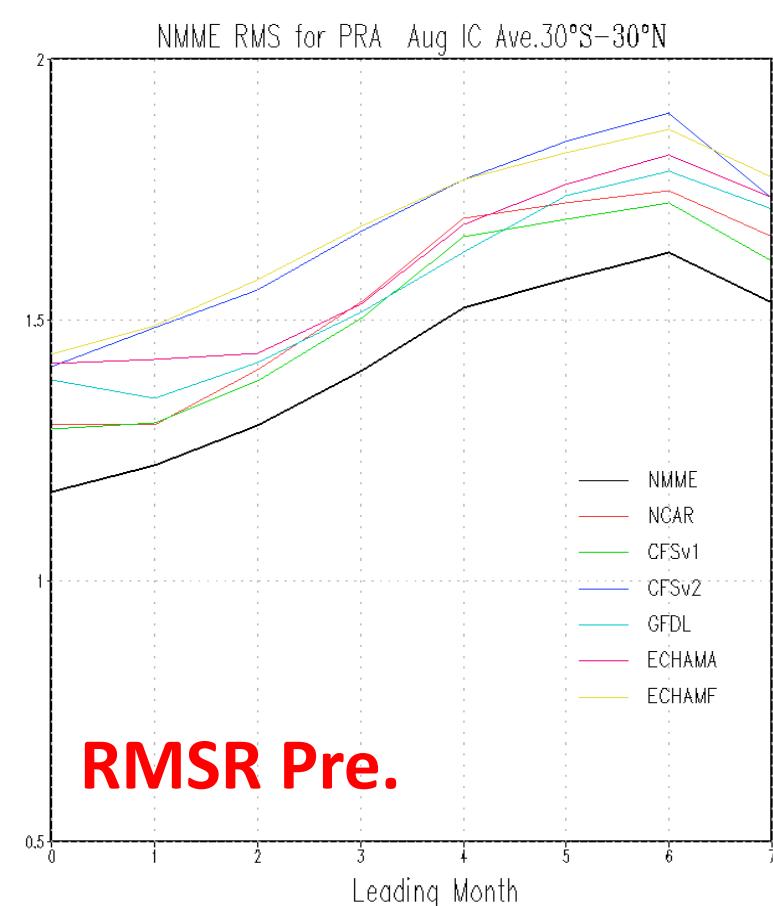
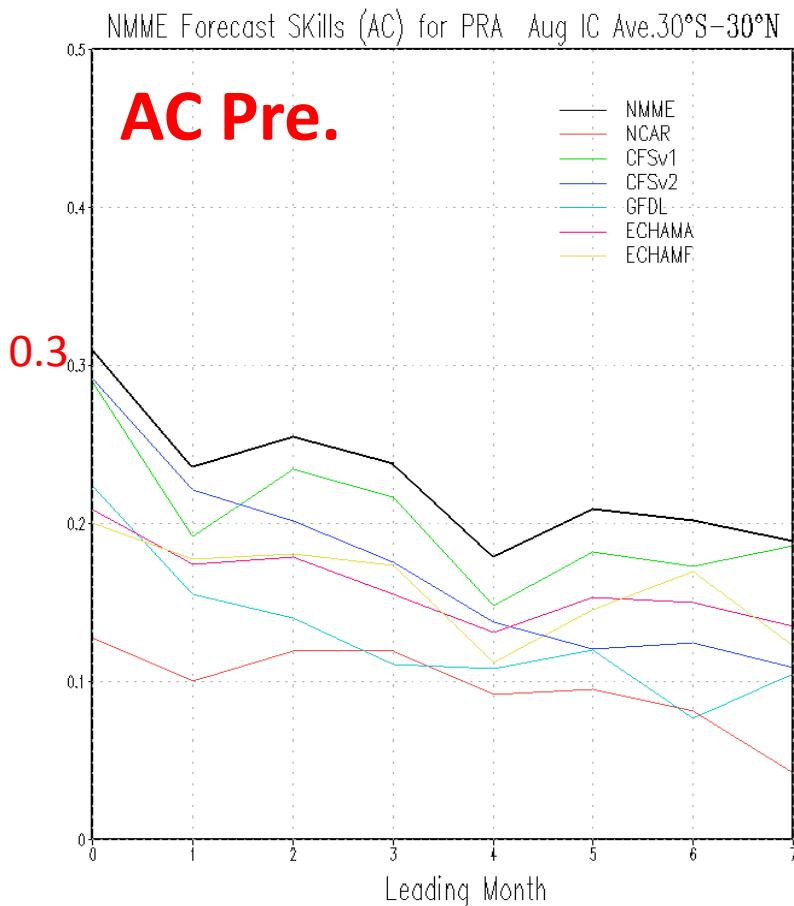
NMME: Hindcast Situation

| | Period | Members |
|-----------------------------|-----------|---------|
| CFSv1 Saha | 1981-2009 | 15 |
| CFSv2 Saha | 1982-2009 | 24(28) |
| GFDL-CM2.1 (Rosati, Gudgel) | 1982-2010 | 10 |
| IRI-Echam4-f (DeWitt) | 1982-2010 | 12 |
| IRI-Echam4-a (DeWitt) | 1982-2010 | 12 |
| CCSM3.0 (Kirtman) | 1982-2010 | 6 |
| NASA Schubert + Canada | 1981-2010 | 6/8*** |

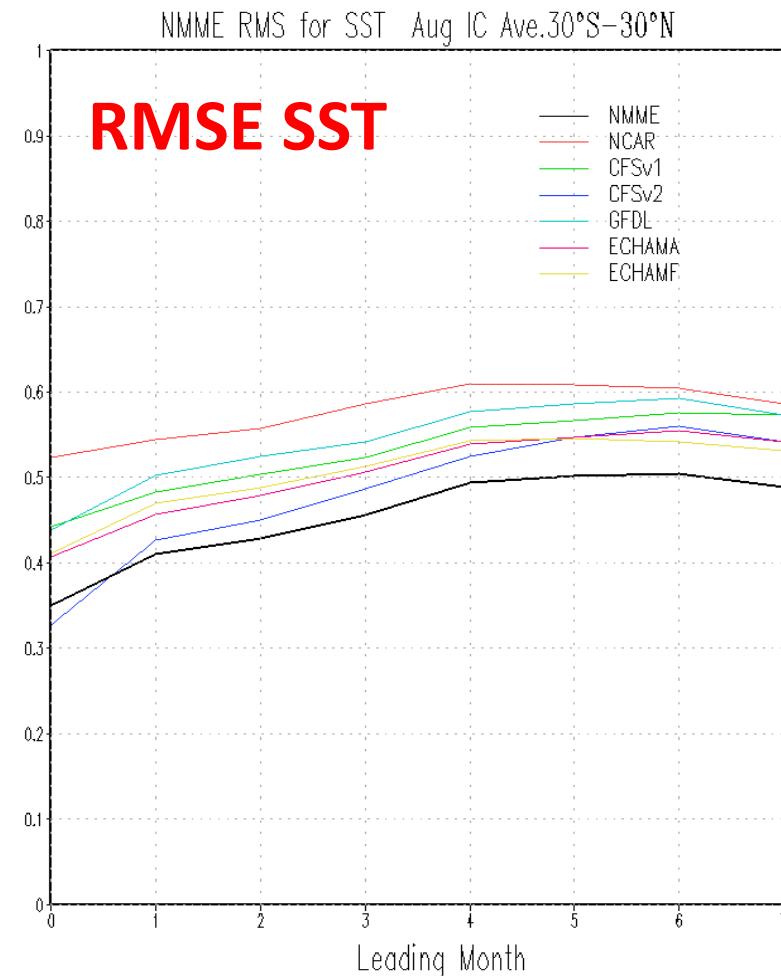
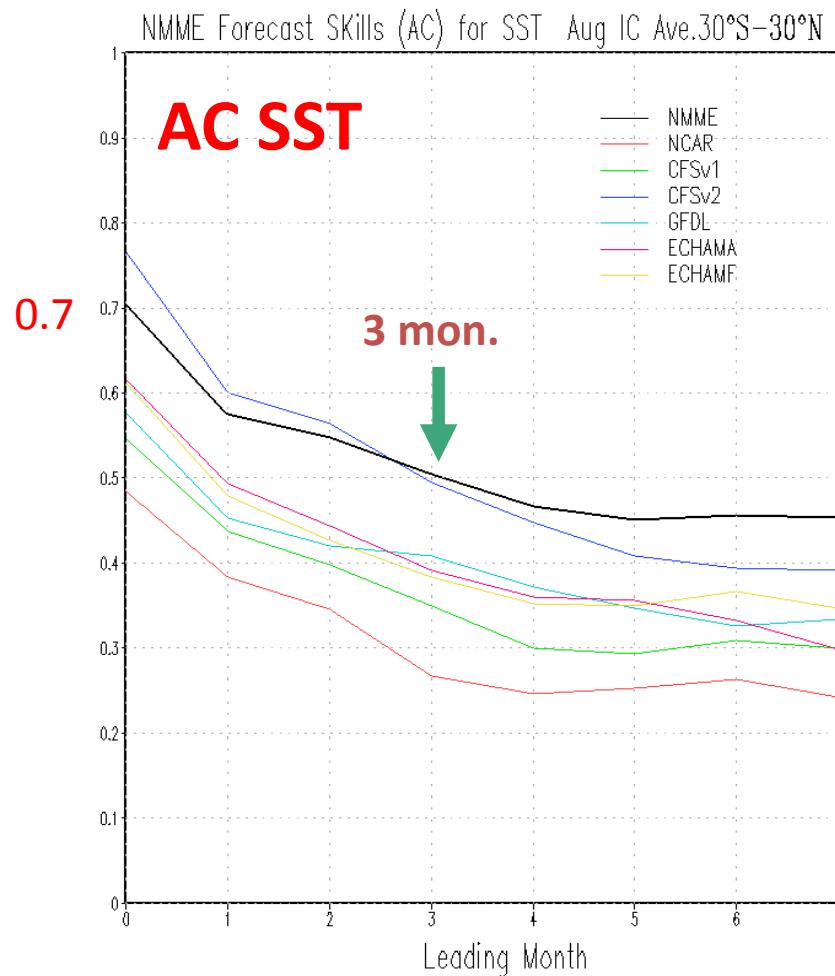
NMME Forecast Skills and RMS Error of T2m (Ave. 30S-30N)



NMME Forecast Skills and RMS Error of Precipitation (Ave. 30S-30N)



NMME Forecast Skills and RMS Error of SST (Ave. 30S-30N)



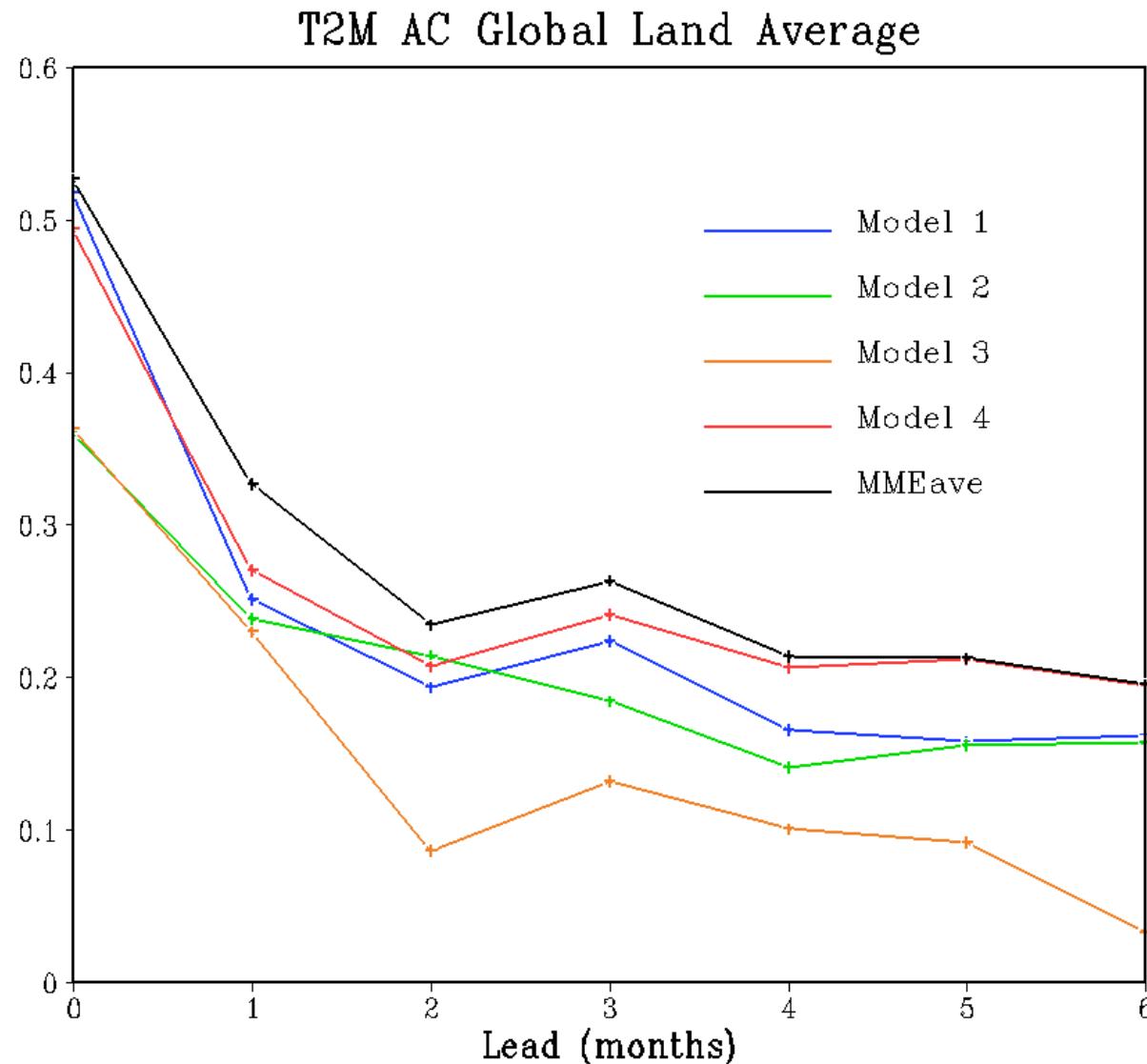
IMME= CFS+ EUROSIP MODELS

| | NCEP/CFSv1 | NCEP/CFSv2 | ECMWF | UKMET | METF |
|-------------------------------------|--------------------------------------|--|--|--|------------------------------------|
| Atmospheric Model | T62L64 | T126L64 | Syst 3: T159L62 | Glosea4 (120km) L85 | T42L91 (T63-linear grid) |
| Ocean Model | MOM3 L40 0.3 deg Eq, 1deg 65N-75S | MOM4 L40 0.25 deg Eq, 0.5 deg global | HOPE L29 0.3 deg Eq 1 deg global | NEMO L75 0.3 deg Eq 1 deg global | ORCA 0.5 deg Eq 2 deg global |
| Atmosphere/Ocean Coupling Frequency | 24 hours | 30 minutes | NA* | NA* | NA* |
| Land Model | OSU 2-layer | NOAH 4-layer | NA* | NA* | NA* |
| Sea Ice Model | Climatological Seoice | 3-layer interactive Seoice model | NA* | NA* | NA* |
| Period of Hindcasts | 1981-2009 (29 years) | 1982-2010 (29 years) | 1981-2009 (29 years) | 1989-2002 (14 years) | 1981-2009 (29 years) |
| Number of hindcast members | 15 | 24(28) | 11 | 12 | 11 |
| Number of Leads | 0-9 months | 0-9 months | 0-7 months | 0-6 months | 0-6 months |

NA* : Not Available, but information requested

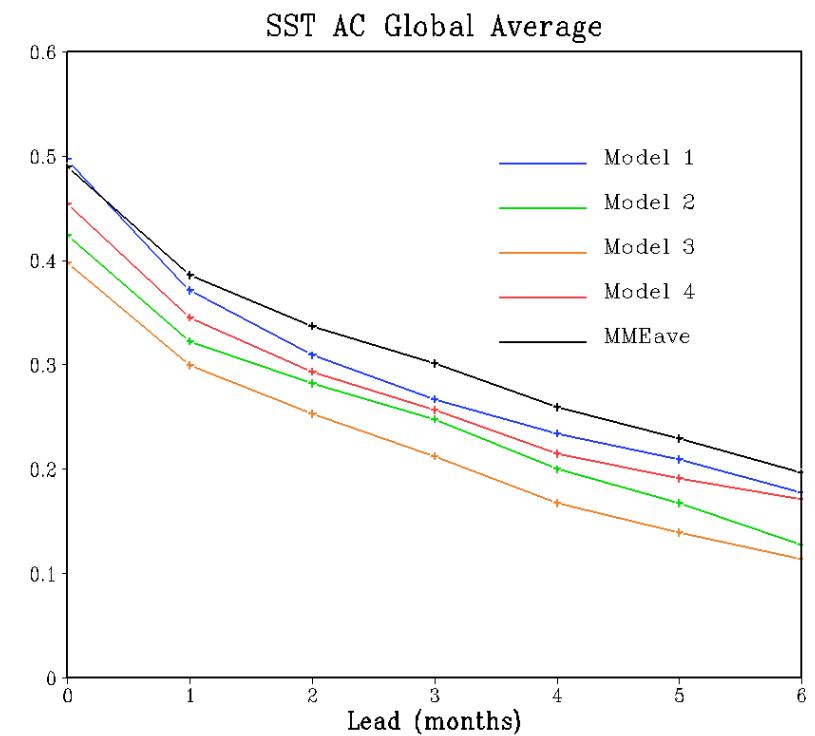
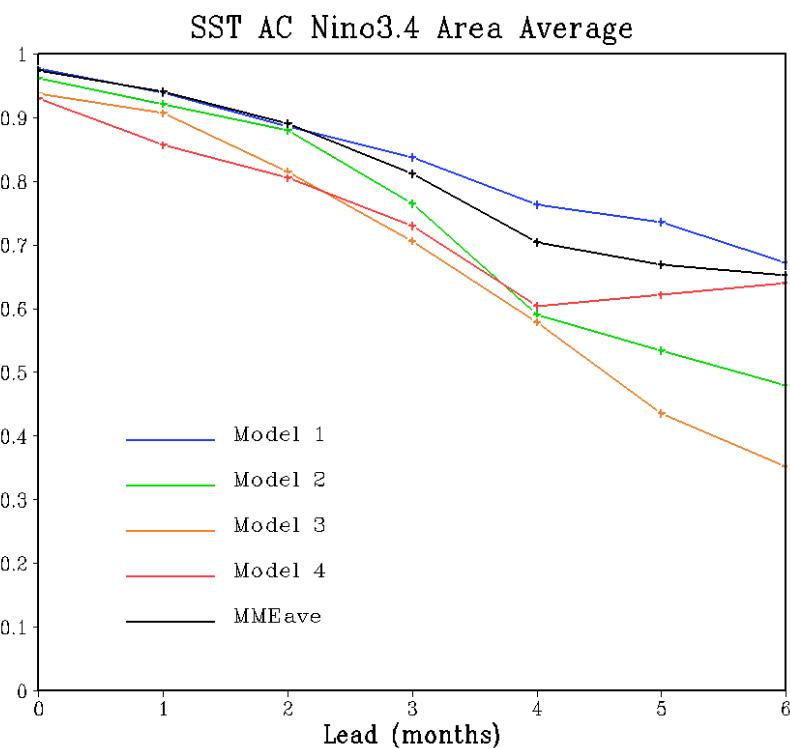
Malaquias Pena Poster

MME average outperforms the other members for 2m T



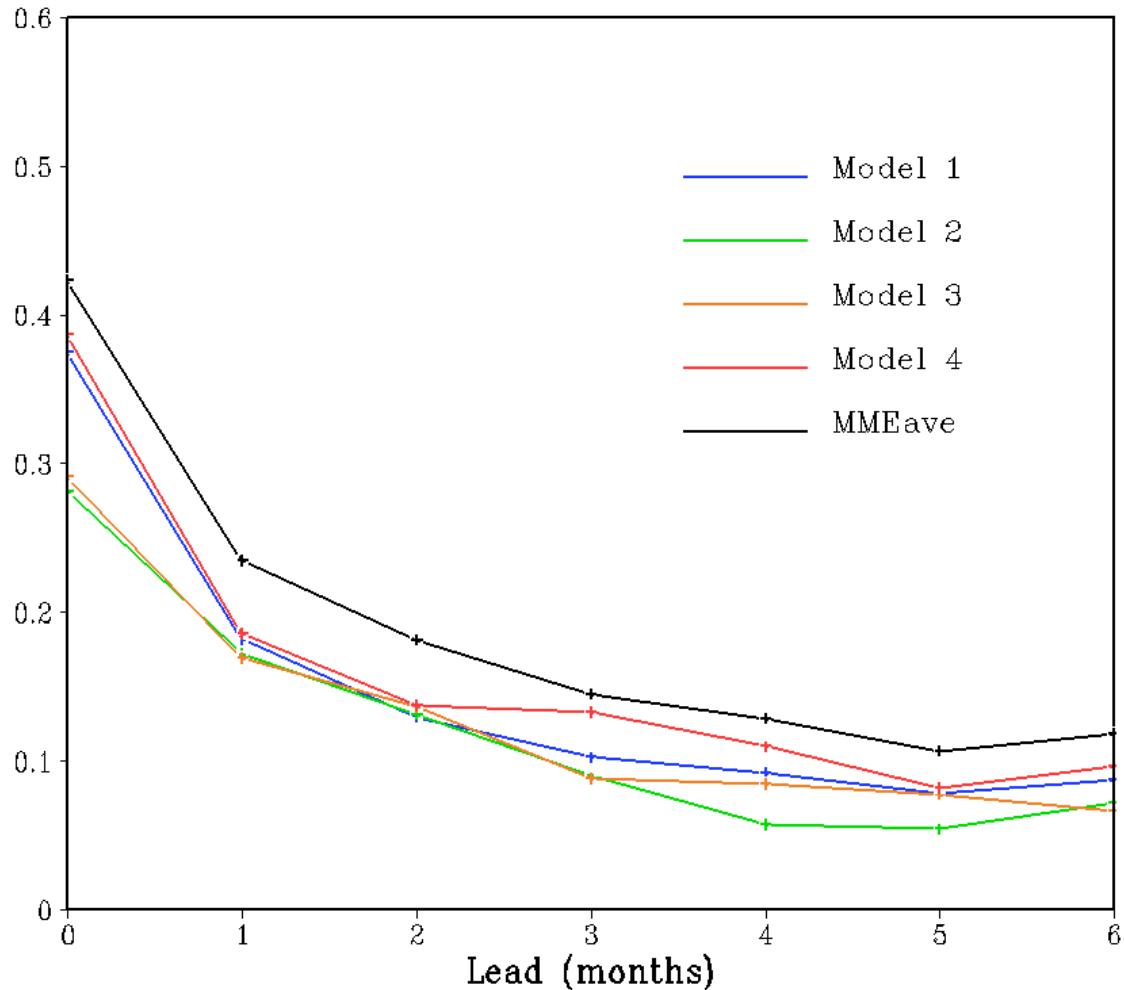
IC Jan 1982-2008; Full data

SST anomaly correlation



I.C. Jan. 1982-2008

PRATE. Anomaly correlation. Global average

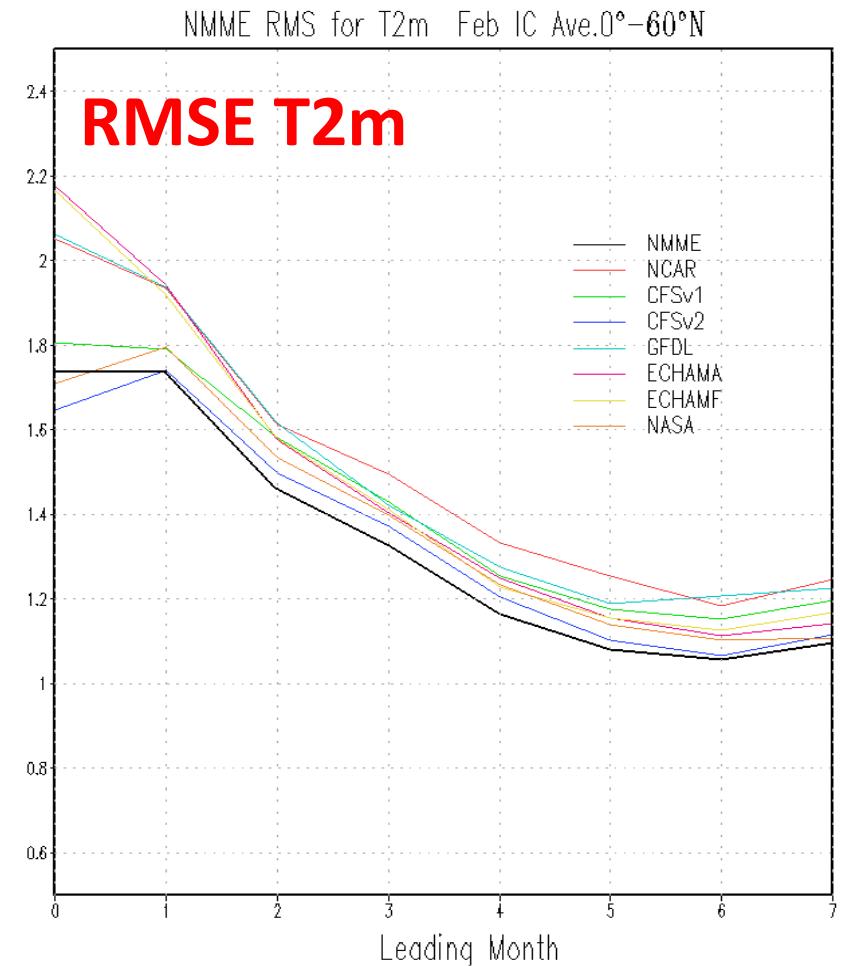
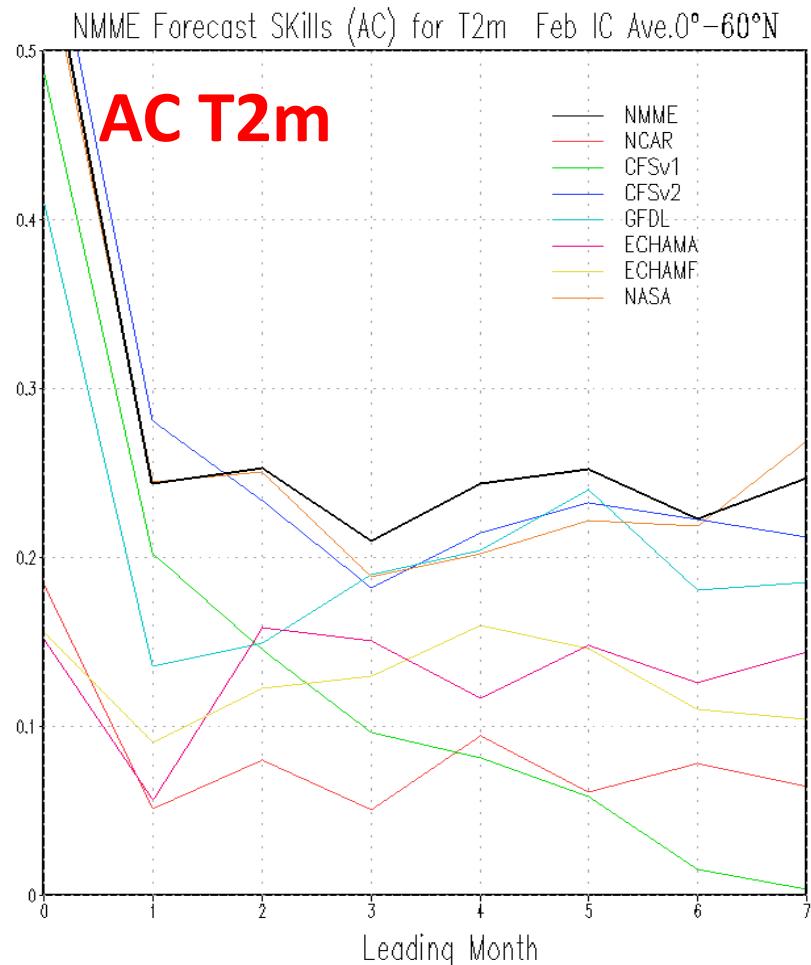


Initial month: Jan. Years 1982-2006

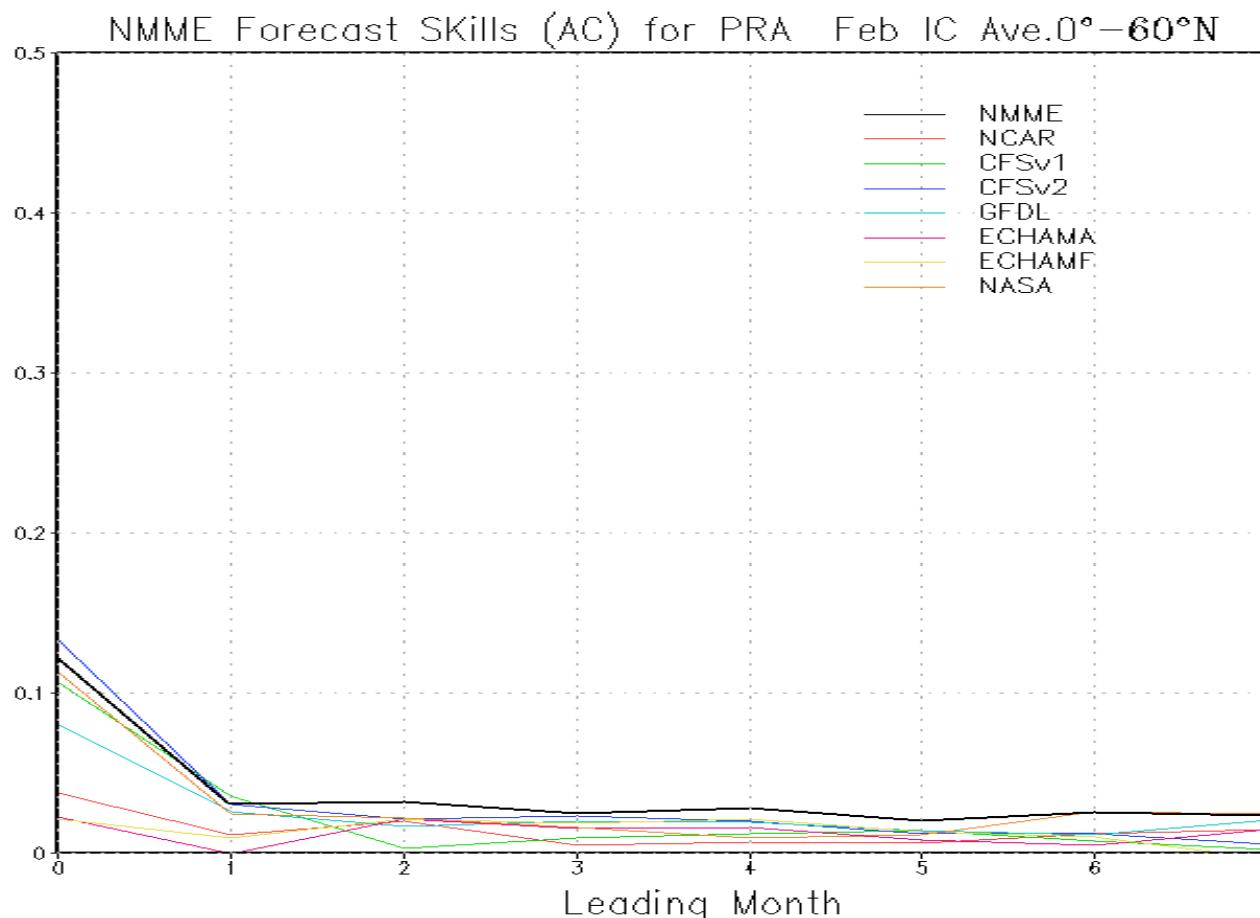
EUROSIP S&T Meeting Feb 14 2012

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NMME Forecast Skills and RMS Error of T2m (over land) (Ave. 0-60°N)

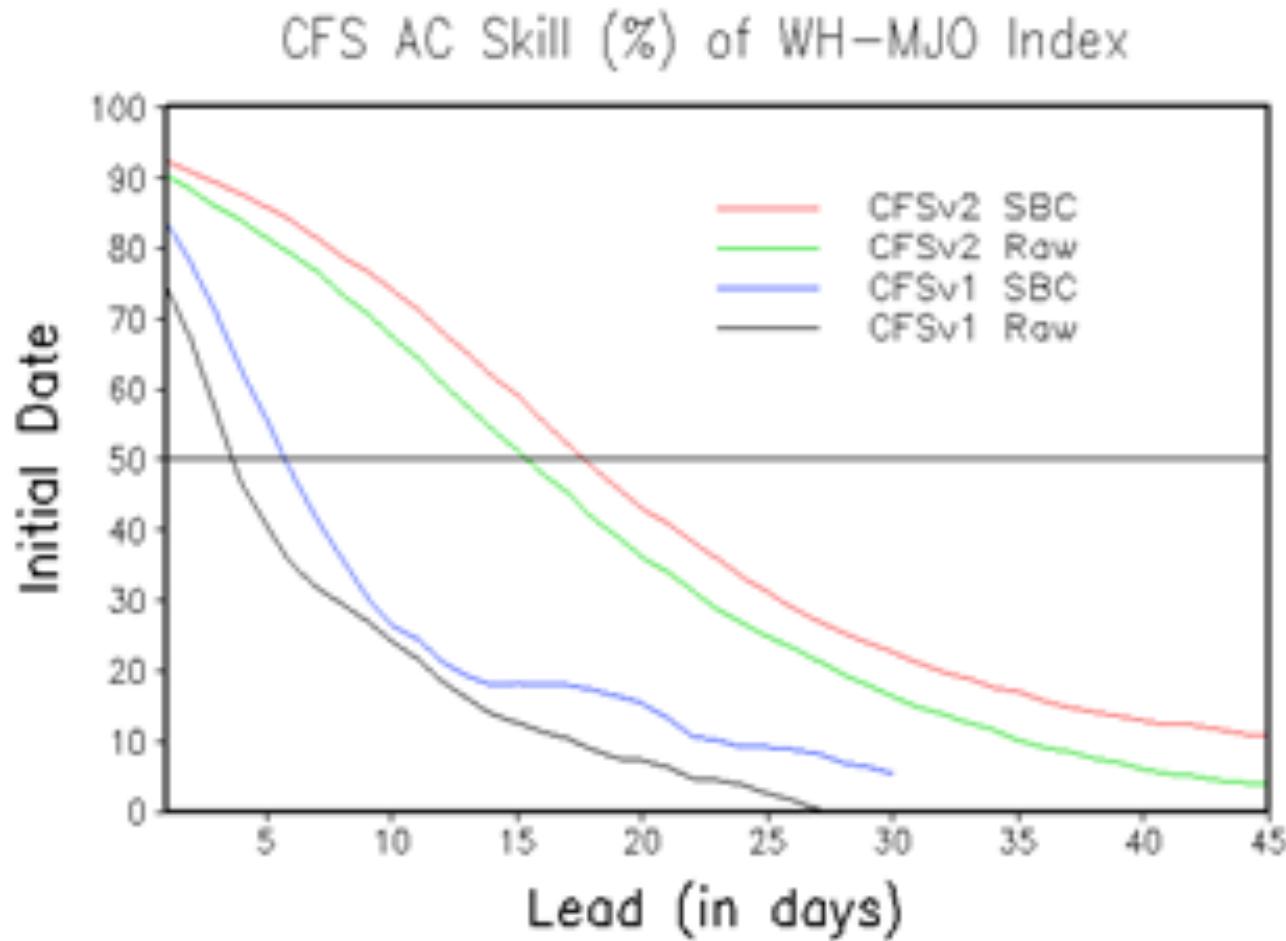


NMME Forecast Skills of Precipitation (over land) (Ave. 0-60N)

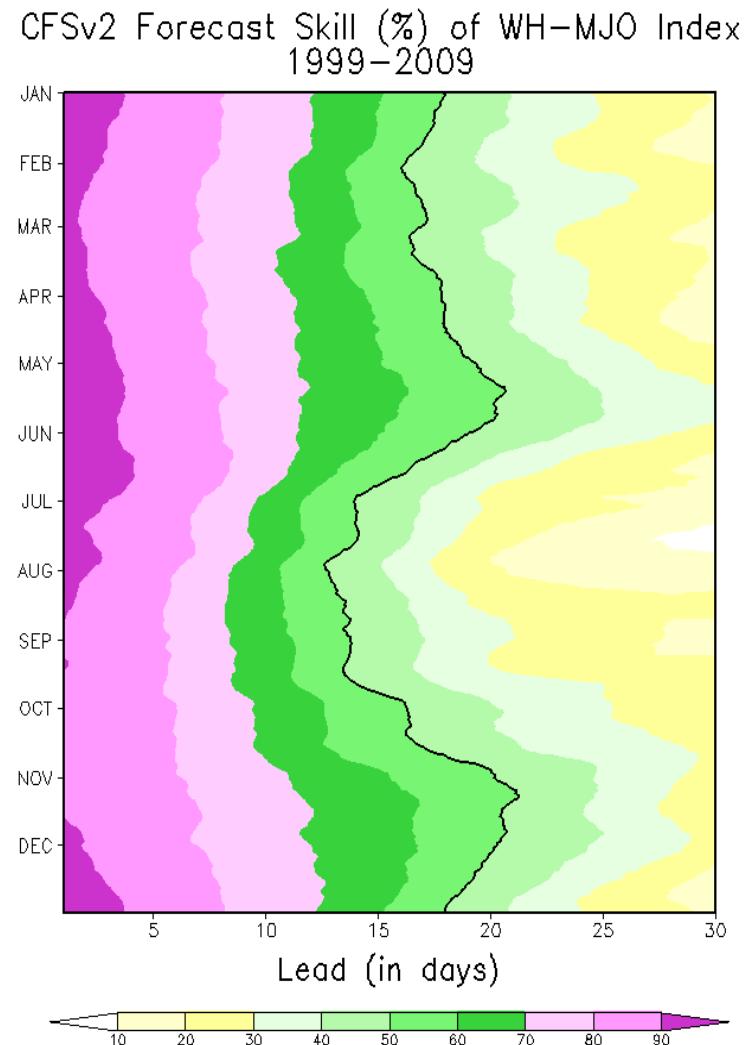
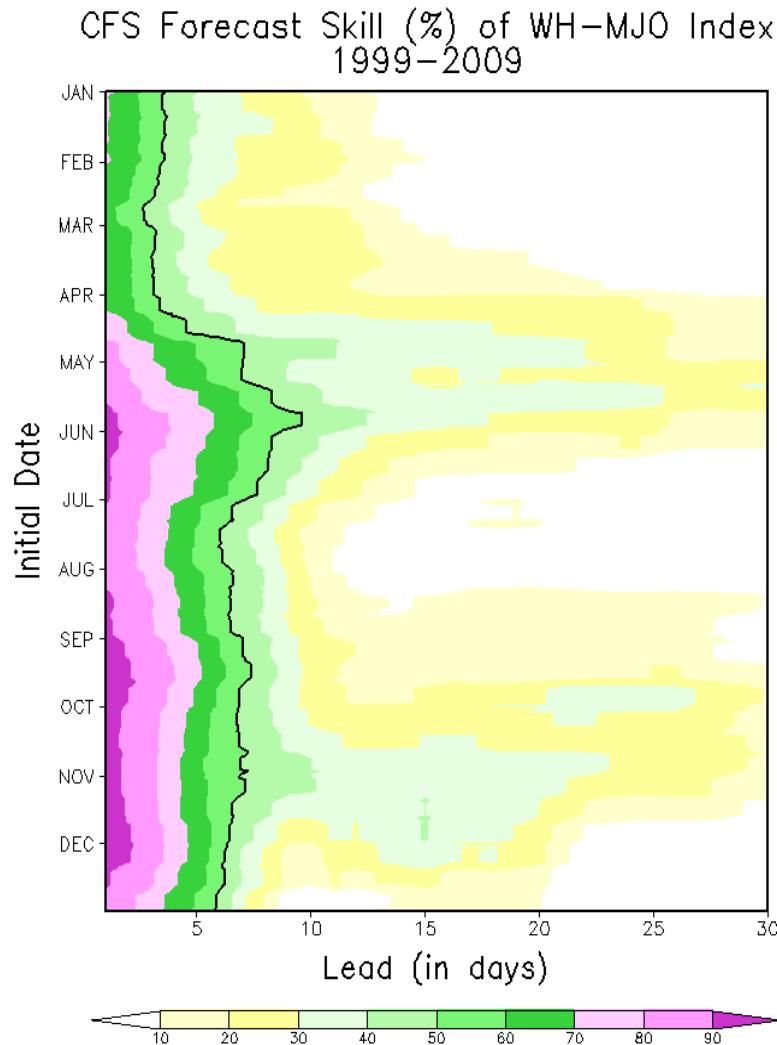


What else about CFSv2?

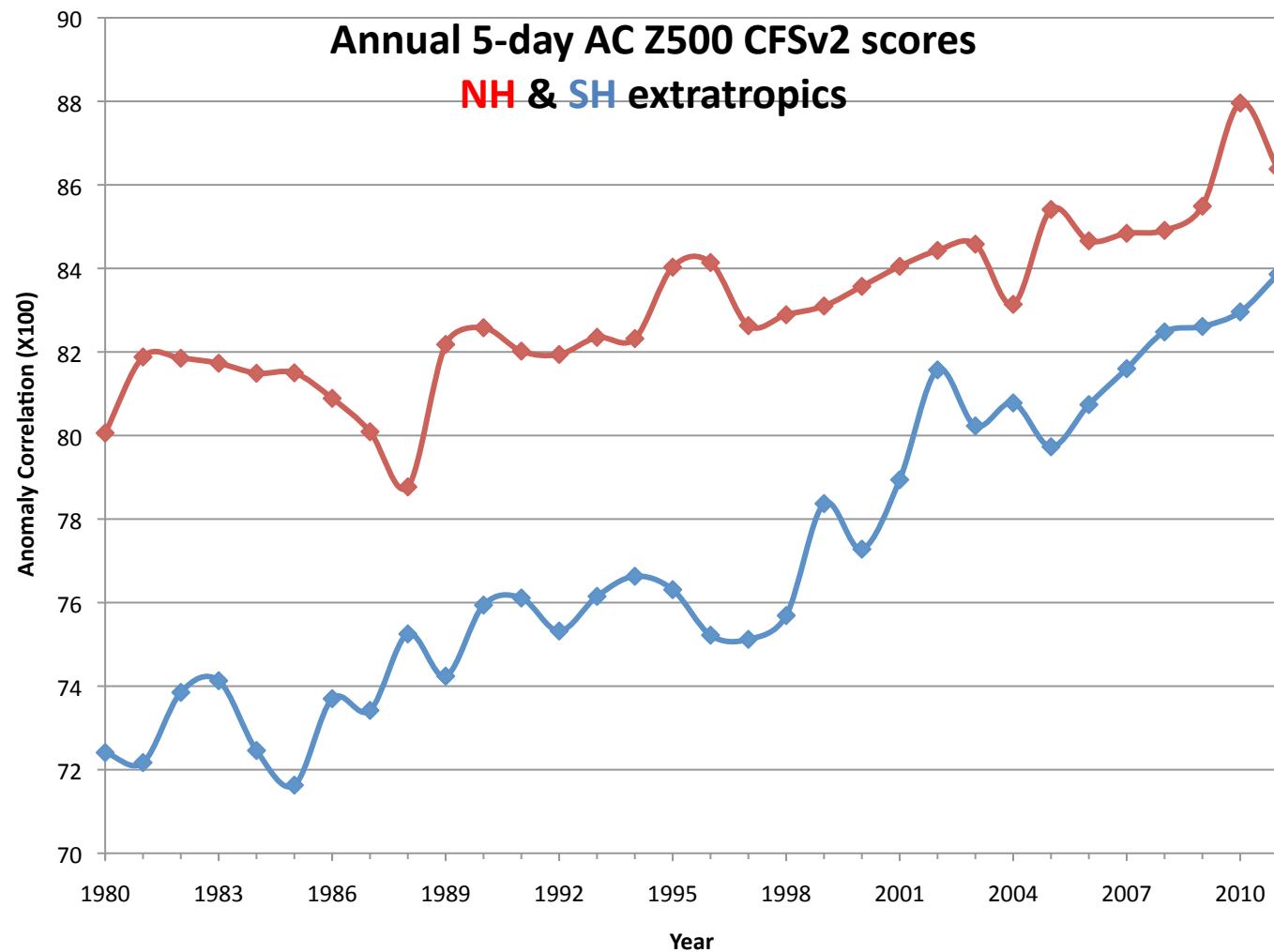
Forecast Skill of WH-MJO index



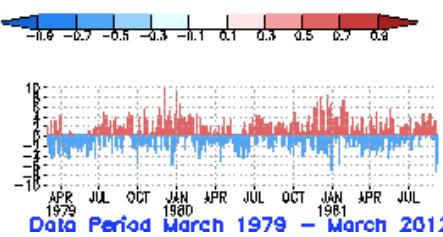
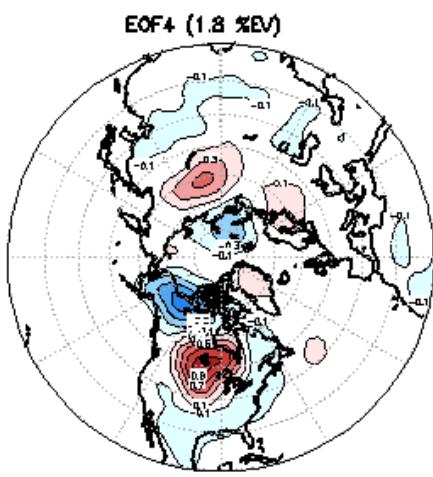
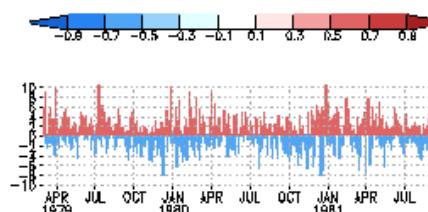
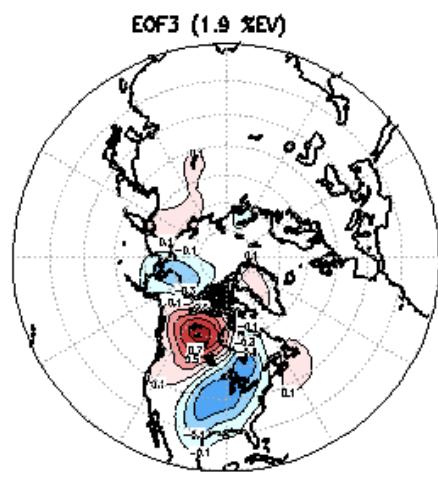
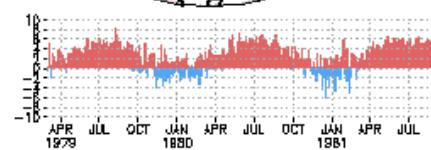
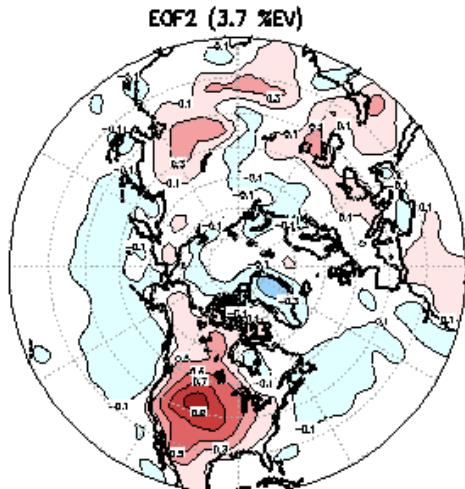
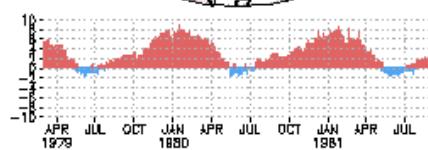
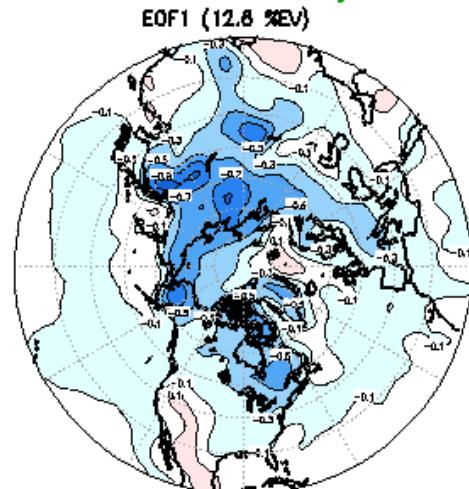
Forecast Skill of WH-MJO index



The not so constant system:



EOF for 5-day CFSv2 forecast error in T 975



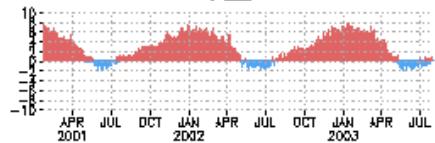
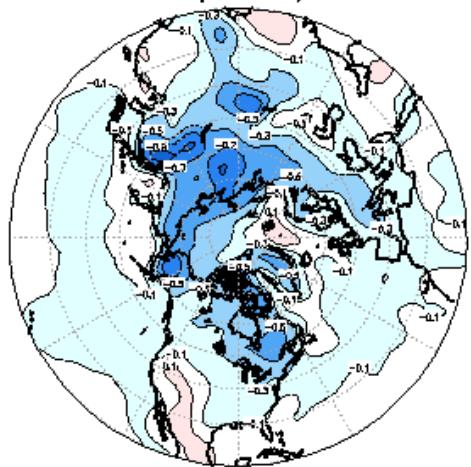
Huua van den Dool, CPC/NCEP/NWS/NOAA

EOF analysis on:
5-day T975 Forecast minus Analysis
X (s,t), NH, t=1,12080 (1979-2012)

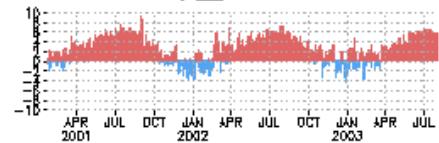
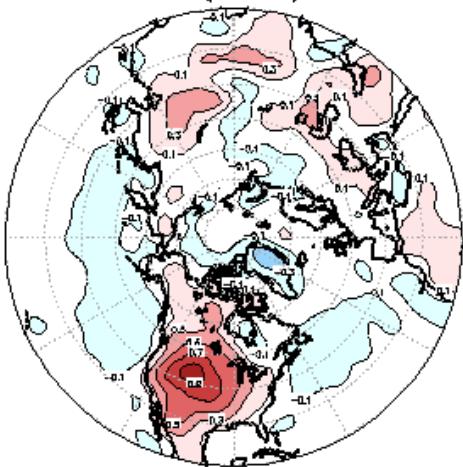
Data Period March 1979 – March 2012

EOF for 5-day CFSv2 forecast error in T 975

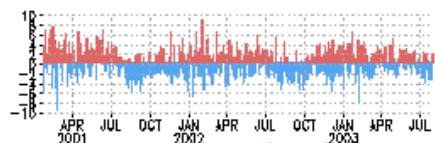
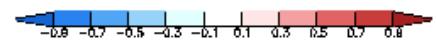
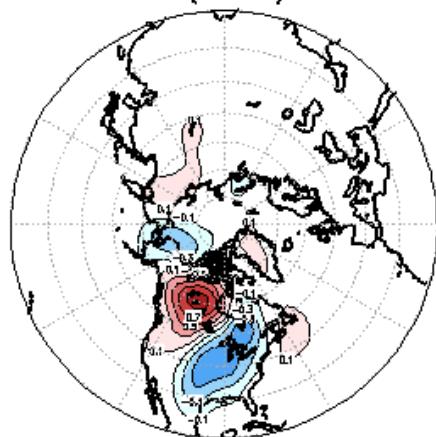
EOF1 (12.8 %EV)



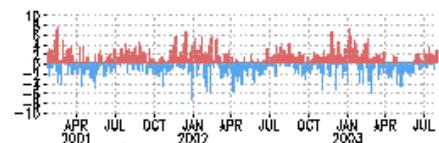
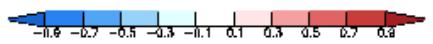
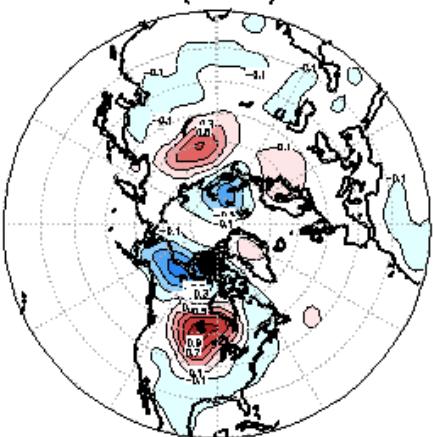
EOF2 (3.7 %EV)



EOF3 (1.9 %EV)



EOF4 (1.8 %EV)



The biggest error in a 5-day
Numerical Weather Prediction
is.....

.....

in the climatology

Fan, Yun, Huug van den Dool, 2011:
Bias Correction and Forecast Skill of NCEP GFS Ensemble
Week-1 and Week-2 Precipitation, 2-m Surface Air Temperature, and Soil Moisture Forecasts.
Wea. Forecasting, **26**, 355–370.

Referrals:

- Poster IMME Malaquias Pena
- Poster MJO Qin Zhang

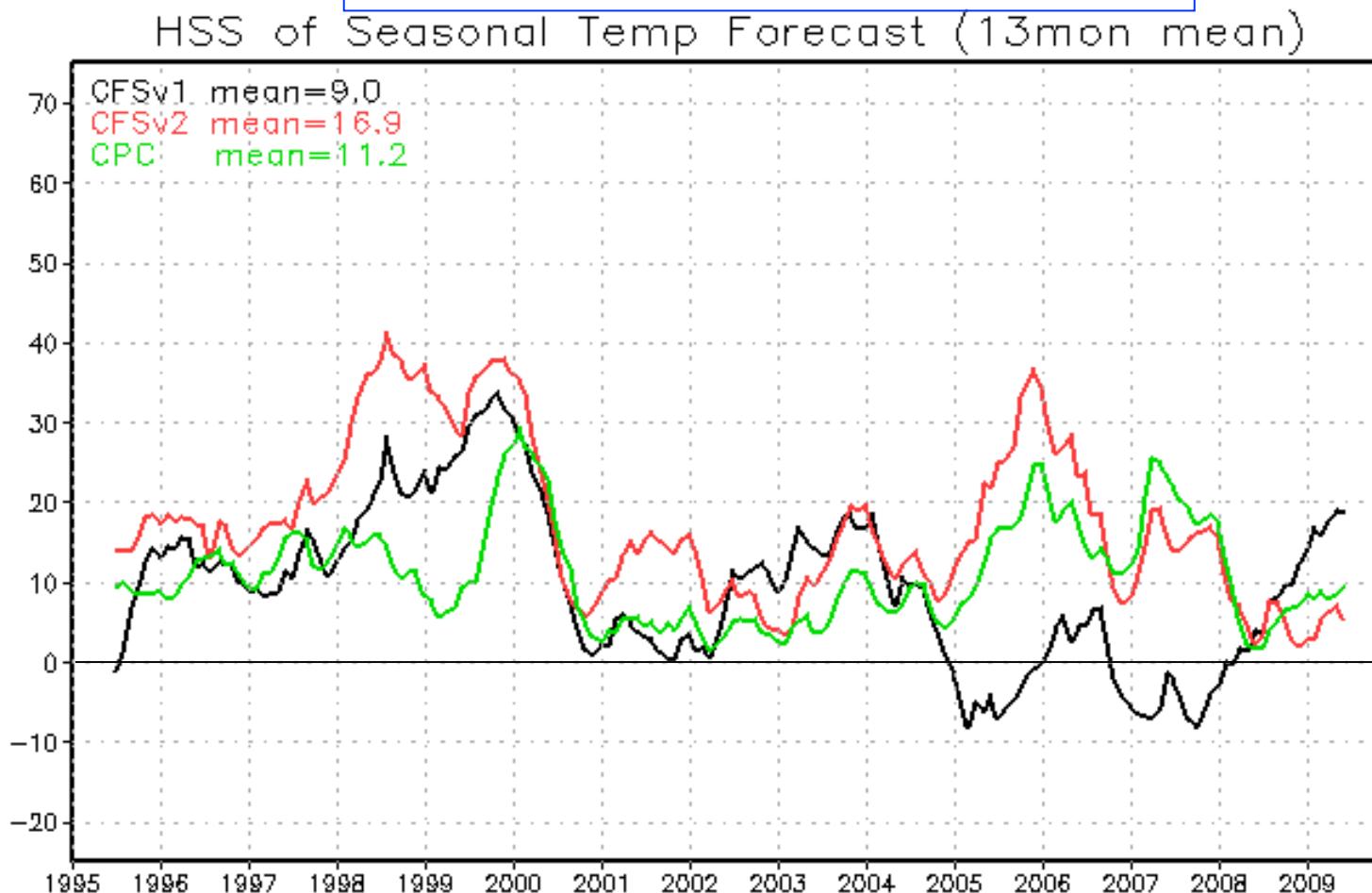
The news about CFSv2

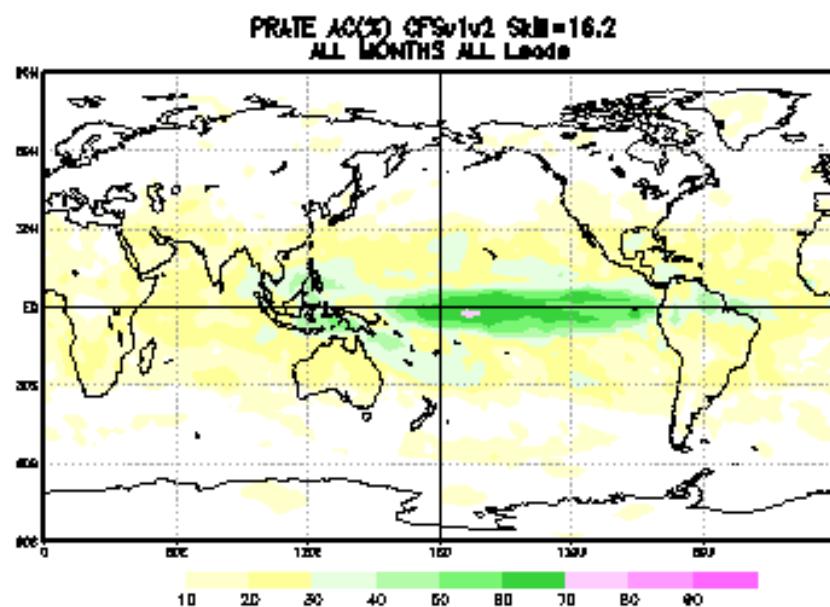
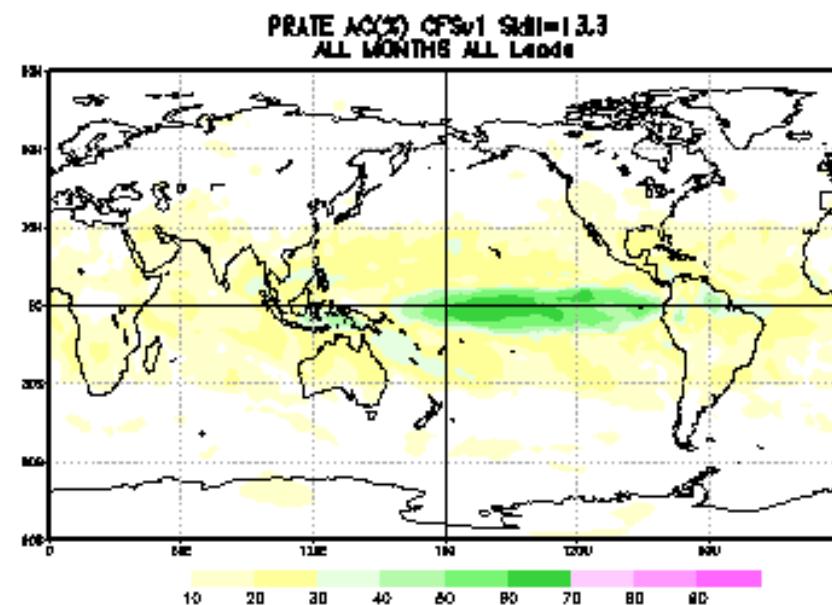
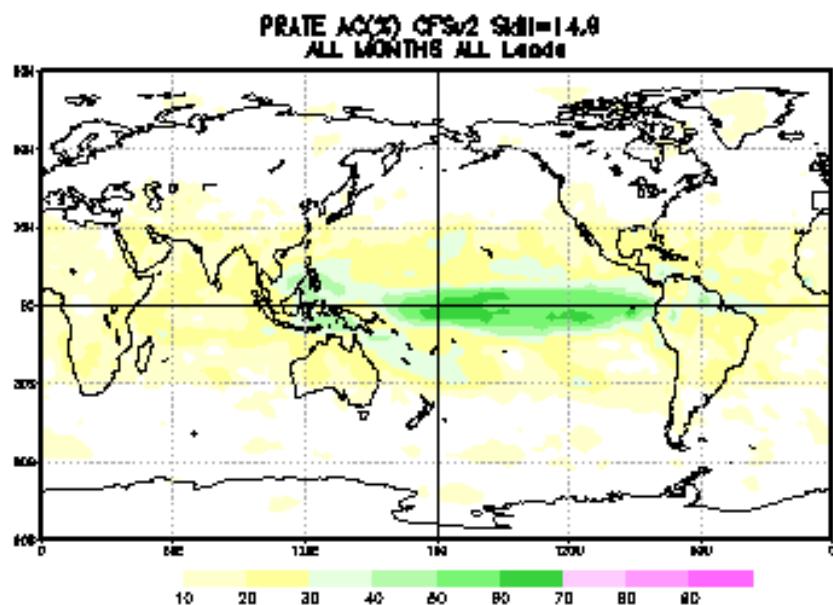
- CFSv2 frequently leads the pack (NMME) in terms of global monthly/seasonal T2m prediction over land. Trends are now modeled with some success in v2. (How easy is this?)
- CFSv2 leads the pack (NMME) in terms of global monthly/seasonal SST prediction. (Nino34 is the exception, unless split climos are used.)
- CFSv2 is just one of the models in the pack (NMME) in terms of global monthly/seasonal prate prediction over land. Very little skill!
- CFSv2's leading role is more pronounced when probabilistic scores are considered, because many more members.
- NMME includes at least one model as good as or better than CFSv2
- CFSv2 is enormously better than CFSv1 in terms of MJO prediction. (CFSR is so much better than R1/R2).
- CFSv2 is run without delay in real time. Therefore, its short&medium range forecasts (16 per day) may (do/should/could) contribute to 6-10day, week2 (vision wk3-wk6).
- The CFSv2 hindcasts are incredibly extensive with 2 foci, SI and intraseasonal.
- The leading day 5 forecast error in CFSv2(&GFS) is not about weather but about climate.

EXTRA

Heidke Skill Score for 2-meter Temp

More skill for CFSv2





HUUG VAN DEN DOOL, CPC/NCEP/NWS/NOAA

Precipitation AC
(All Leads, All Months)

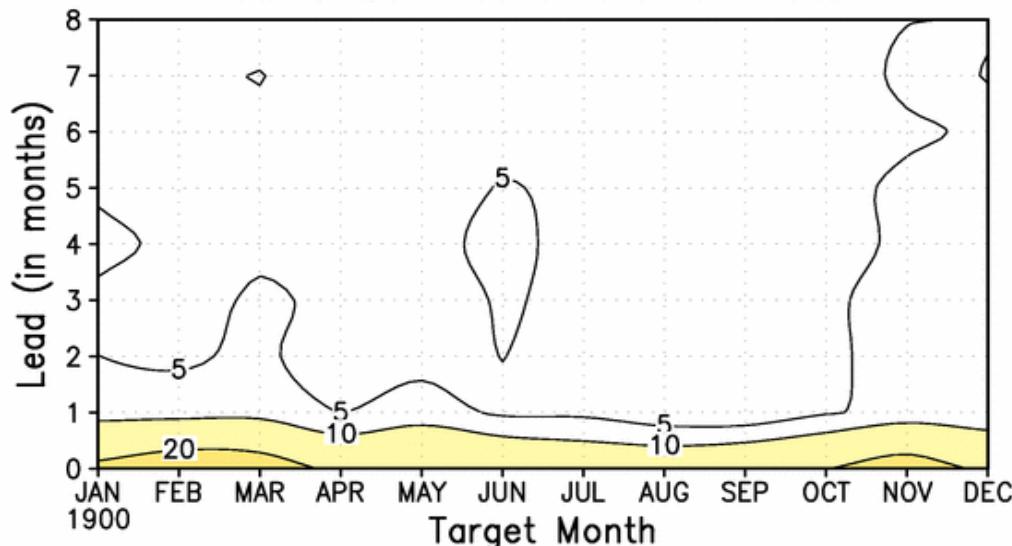
CFSv2: 14.9

CFSv1: 13.3

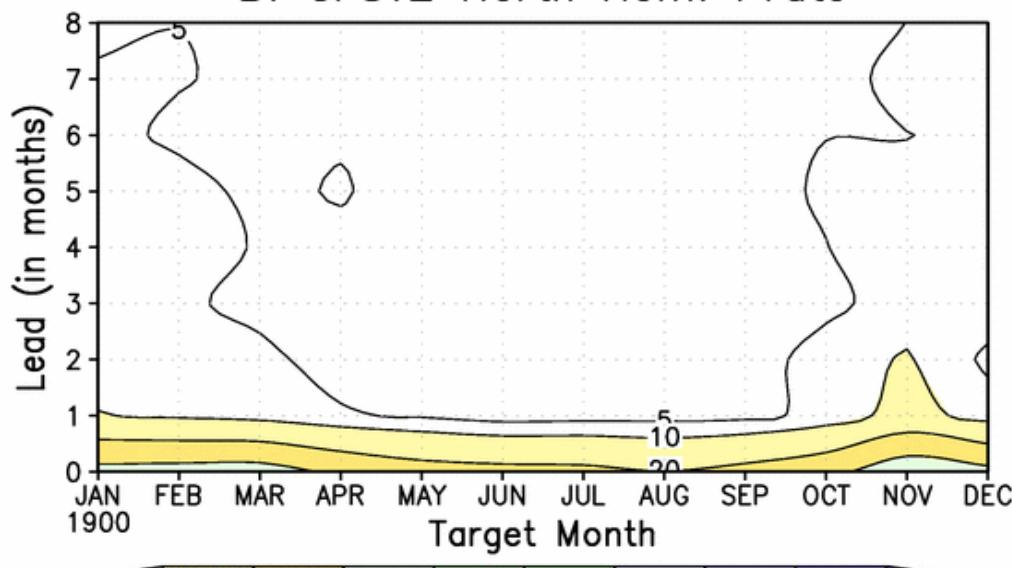
CFSv1v2: 16.2

More skill in the
Western Pacific for
CFSv2

A. CFSv1 North Hem. Prate



B. CFSv2 North Hem. Prate

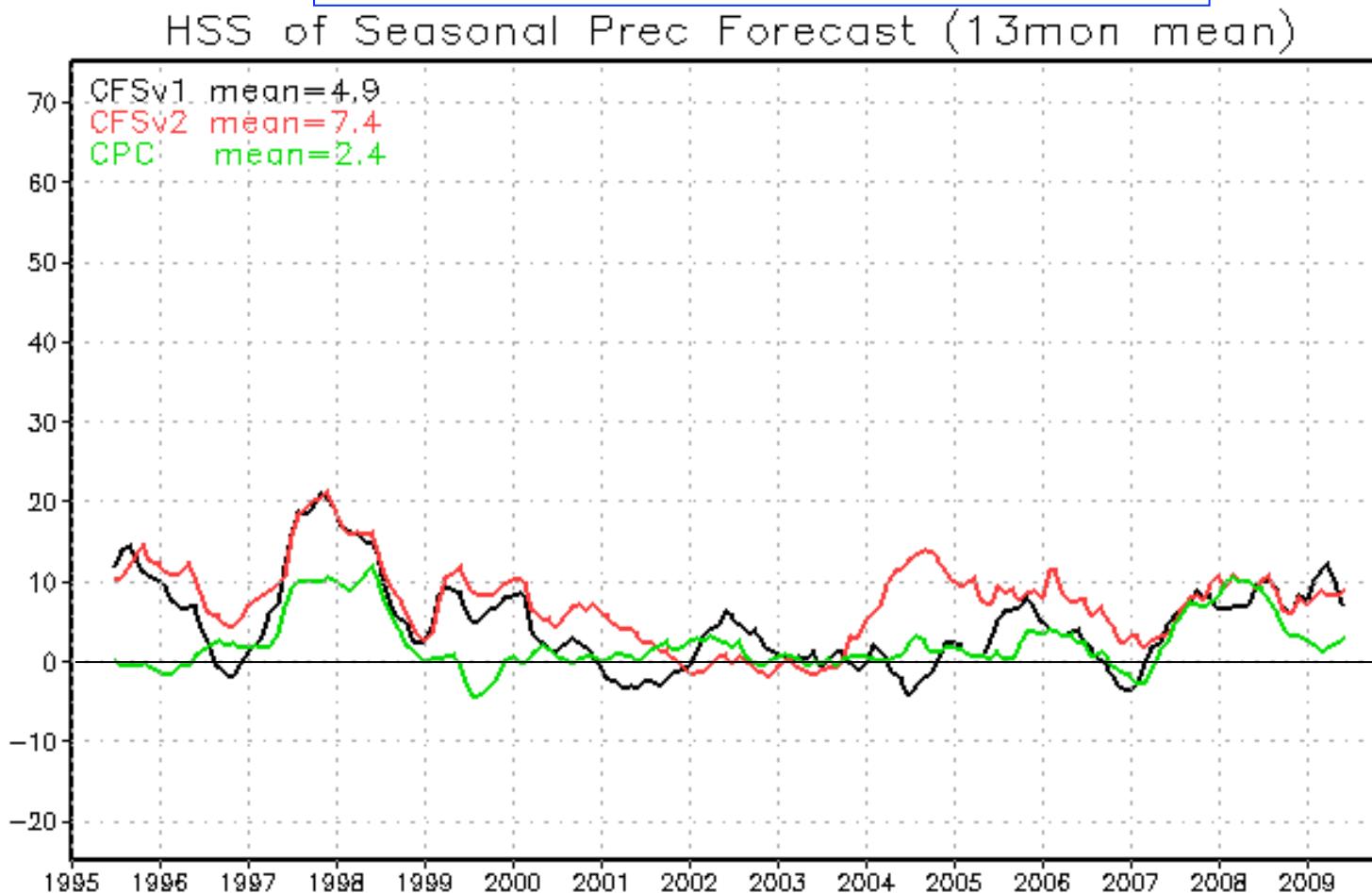


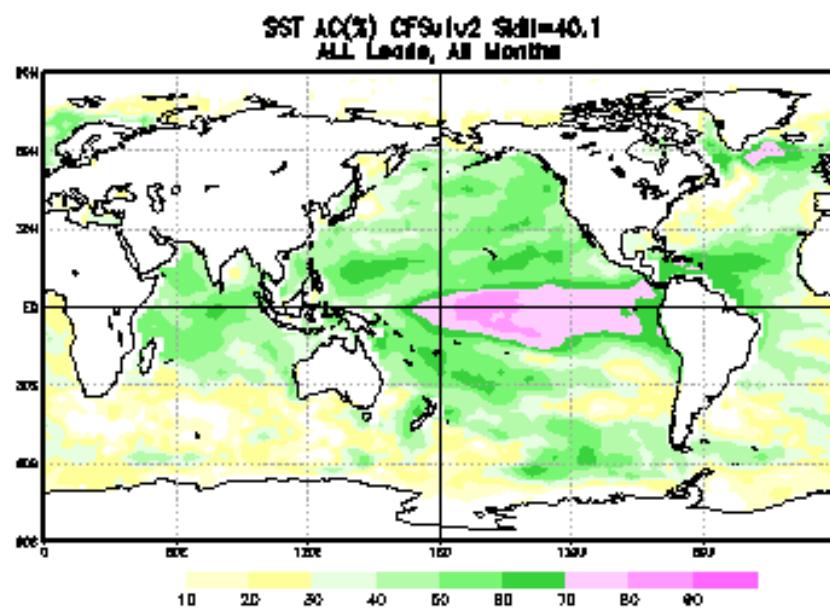
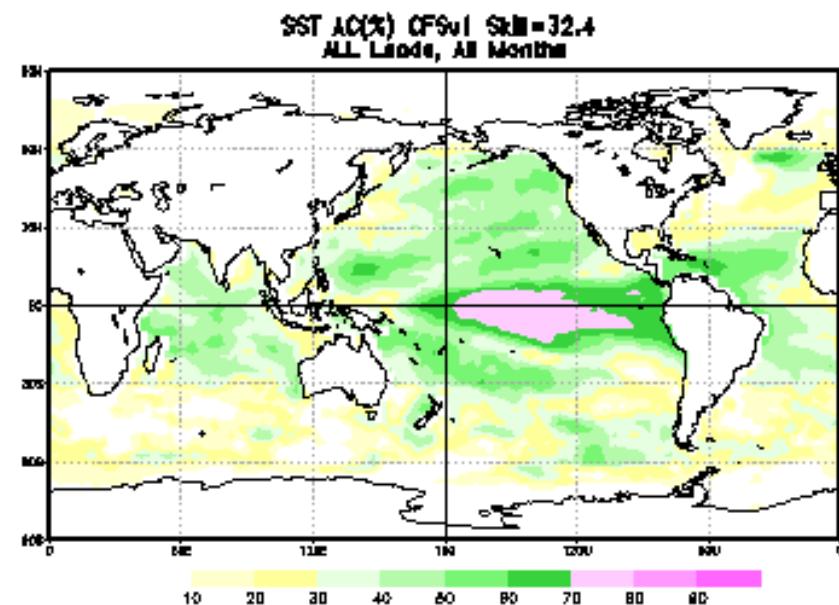
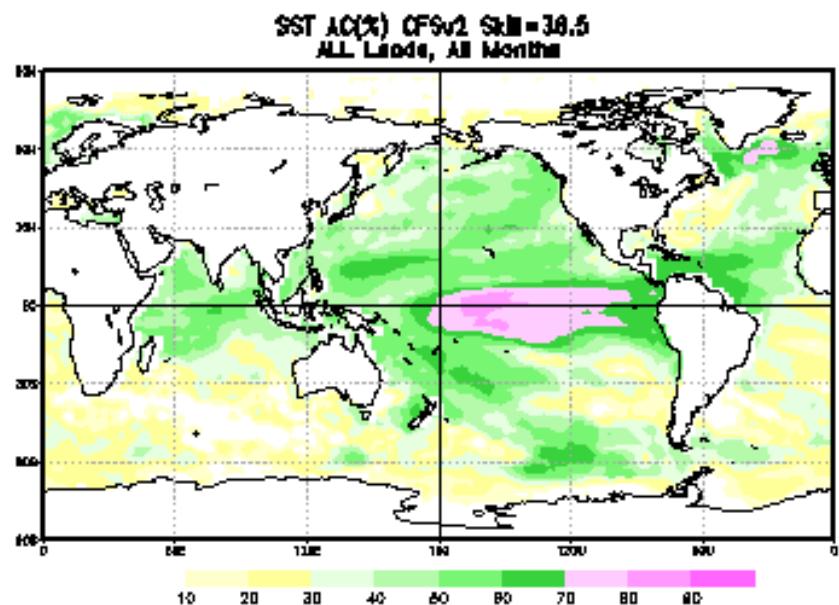
Precipitation Ensemble skill of
Northern Hemisphere (all land
north of 20°N)

Both systems have very little
skill for precipitation

Heidke Skill Score for Precipitation

Slightly more skill for CFSv2





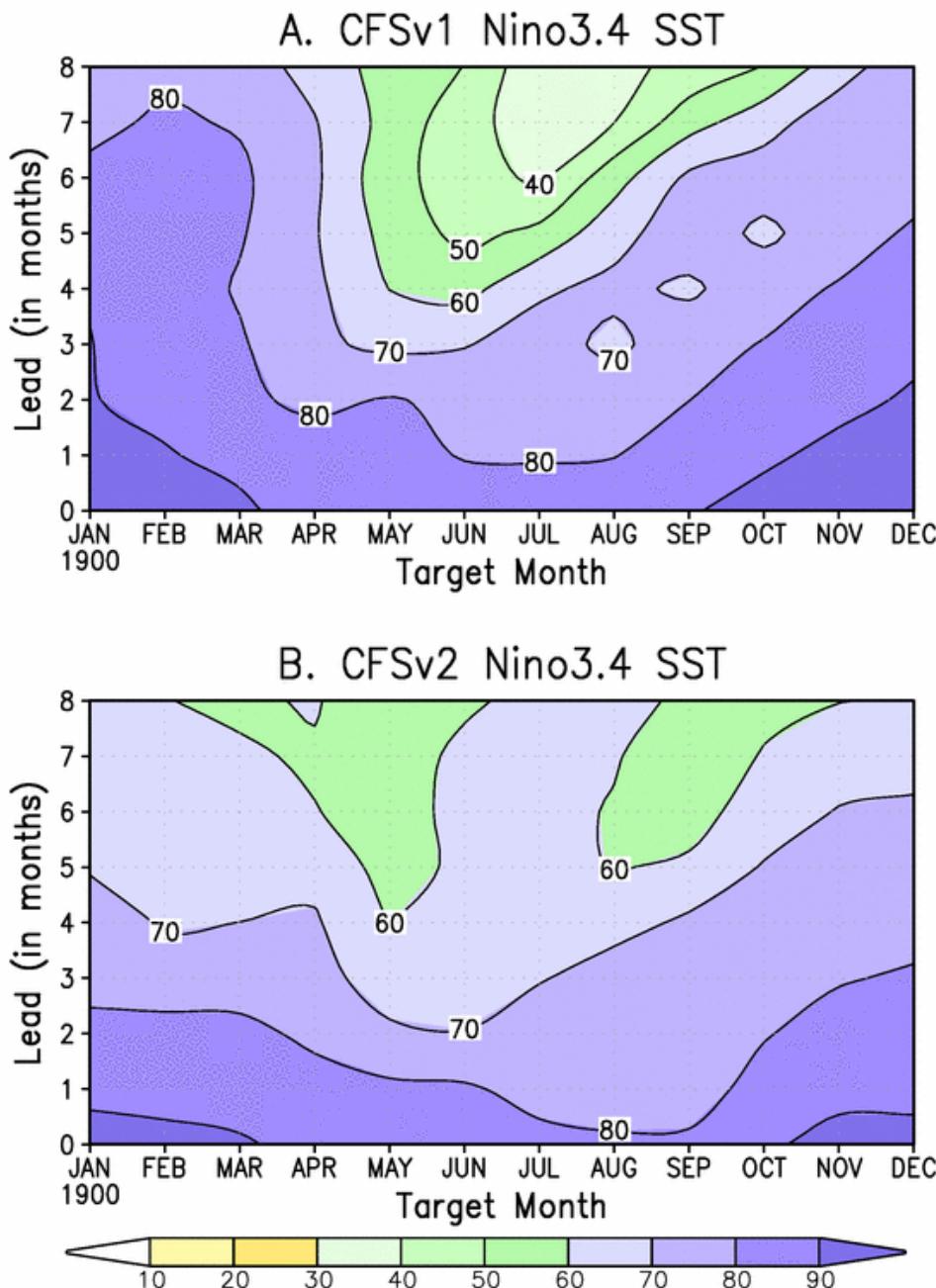
**Sea Surface Temp AC
(All Leads, All Months)**

CFSv2: **36.5**

CFSv1: **32.4**

CFSv1v2: **40.1**

**More skill west of the
dateline and over the
Atlantic for CFSv2**



Sea Surface Temperature Ensemble skill of Nino 3.4

CFSv1 has a problem in that it persists large winter anomalies into the spring (a critical ENSO season) and is reluctant to go to neutral, let alone to go from La Nina to El Nino or vice versa (as is common in spring).

The standard deviation for MAM is clearly improved in CFSv2. There appears to be much less of a “spring barrier” in CFSv2.

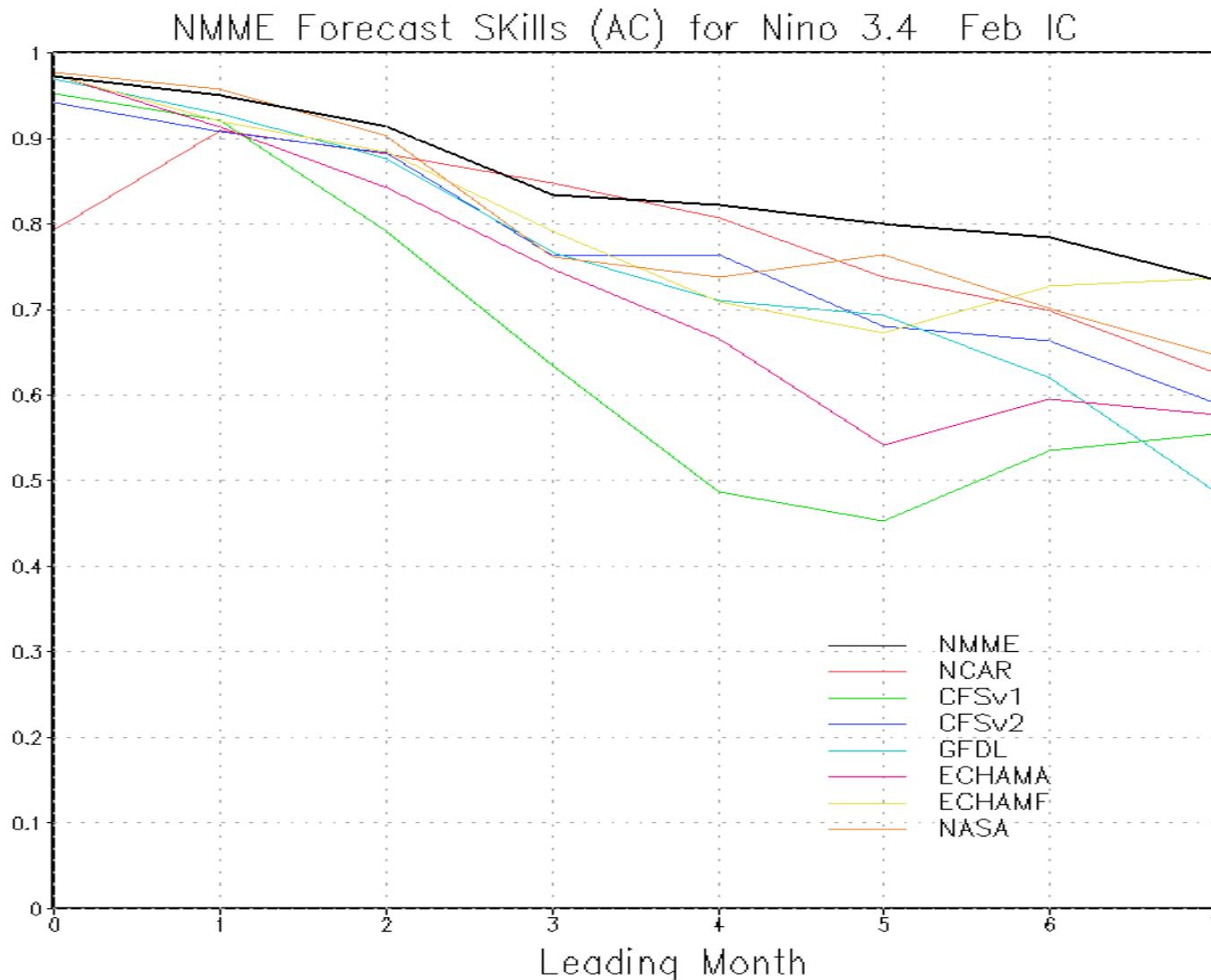
THE BOTTOM LINE

Anomaly Correlation: All Leads (1-8), All Months (10)

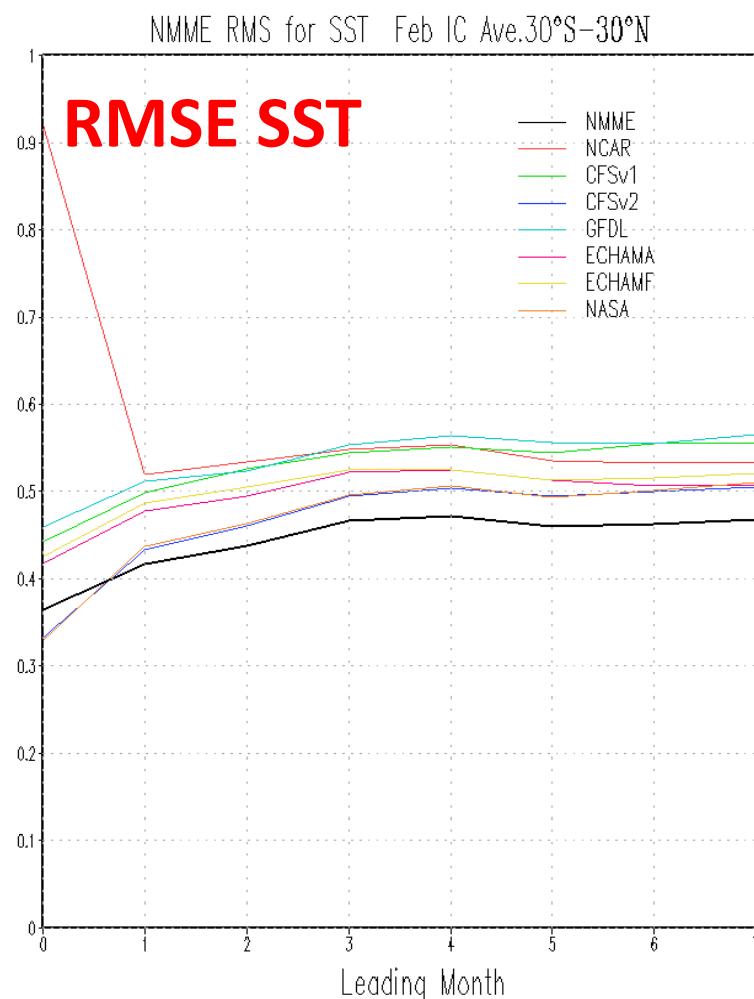
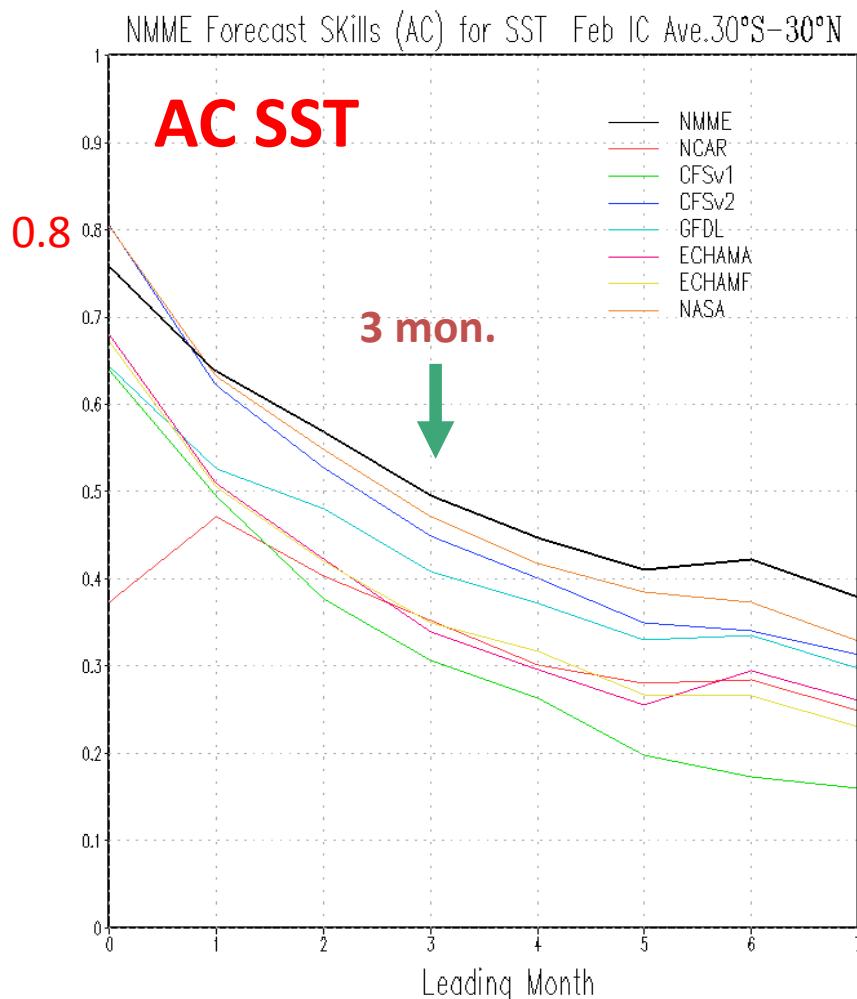
| Model | Green is good | | Red is not good | | |
|-------------------|---------------|--------|-----------------|-----------------|----------------------------|
| | US T | US P | Nino34 SST | Nino34 Prate | Global SST (50N-50S) |
| CFSv2 | 16.3 | 9.5 | 77.2 | 54.5 | 42.2 |
| CFSv1 | 9.5 | 10.3 | 71.8 | 52.8 | 37.7 |
| CFSv1v2 | 15.4 | 12.2 | 78.3 | 57.0 | 45.4 |
| CFSv1v2- CFSv2 | -0.9 | +2.7 | +1.1 | +2.5 | +3.2 |
| %tage change | (-5.8%) | (+22%) | (+1.4%) | (+4.4%) | (+7%) |

NMME Feb starts

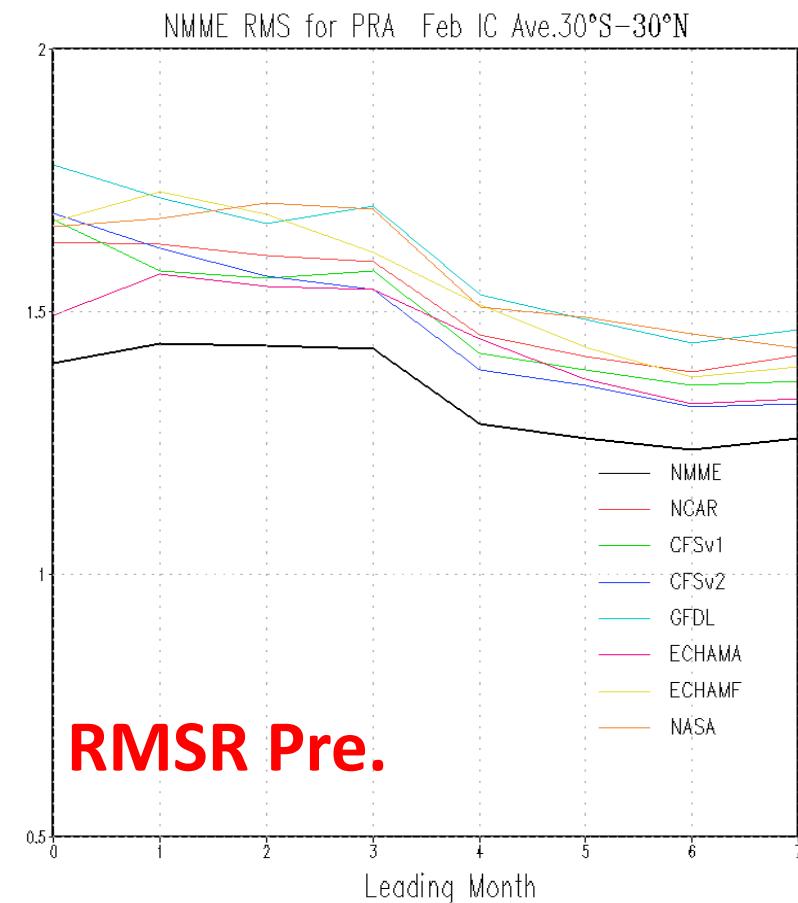
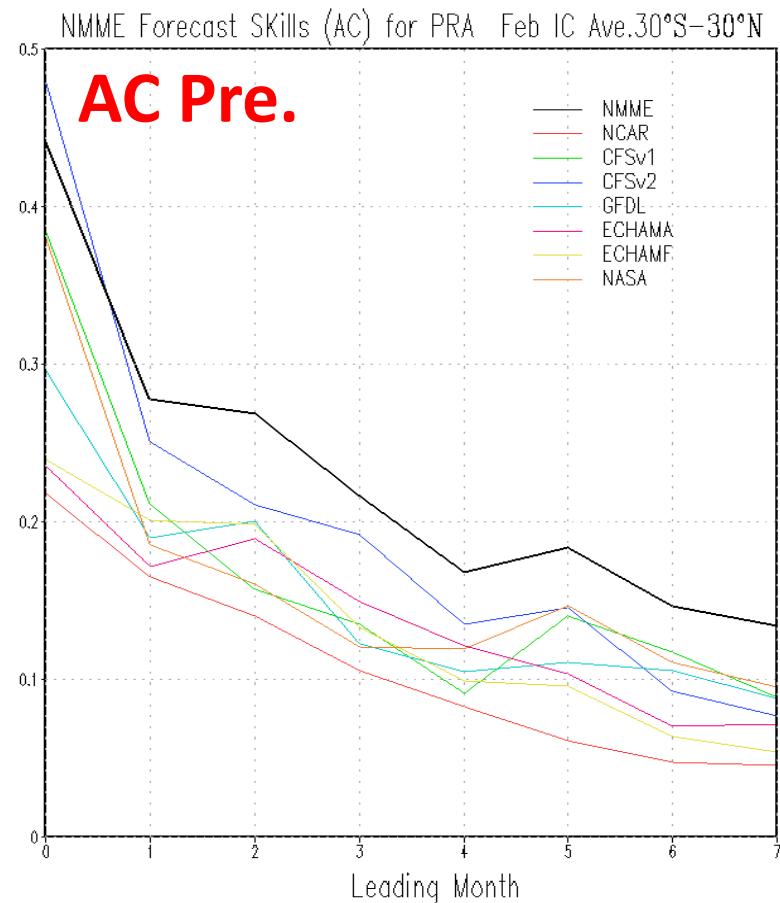
Forecast Skills for NINO3.4 Indices



NMME Forecast Skills and RMS Error of SST (Ave. 30S-30N)



NMME Forecast Skills and RMS Error of Precipitation (Ave. 30S-30N)



NMME Forecast Skills and RMS Error of T2m (Ave. 30S-30N)

